Image Processing of Digital X-Ray Images

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ntroduction

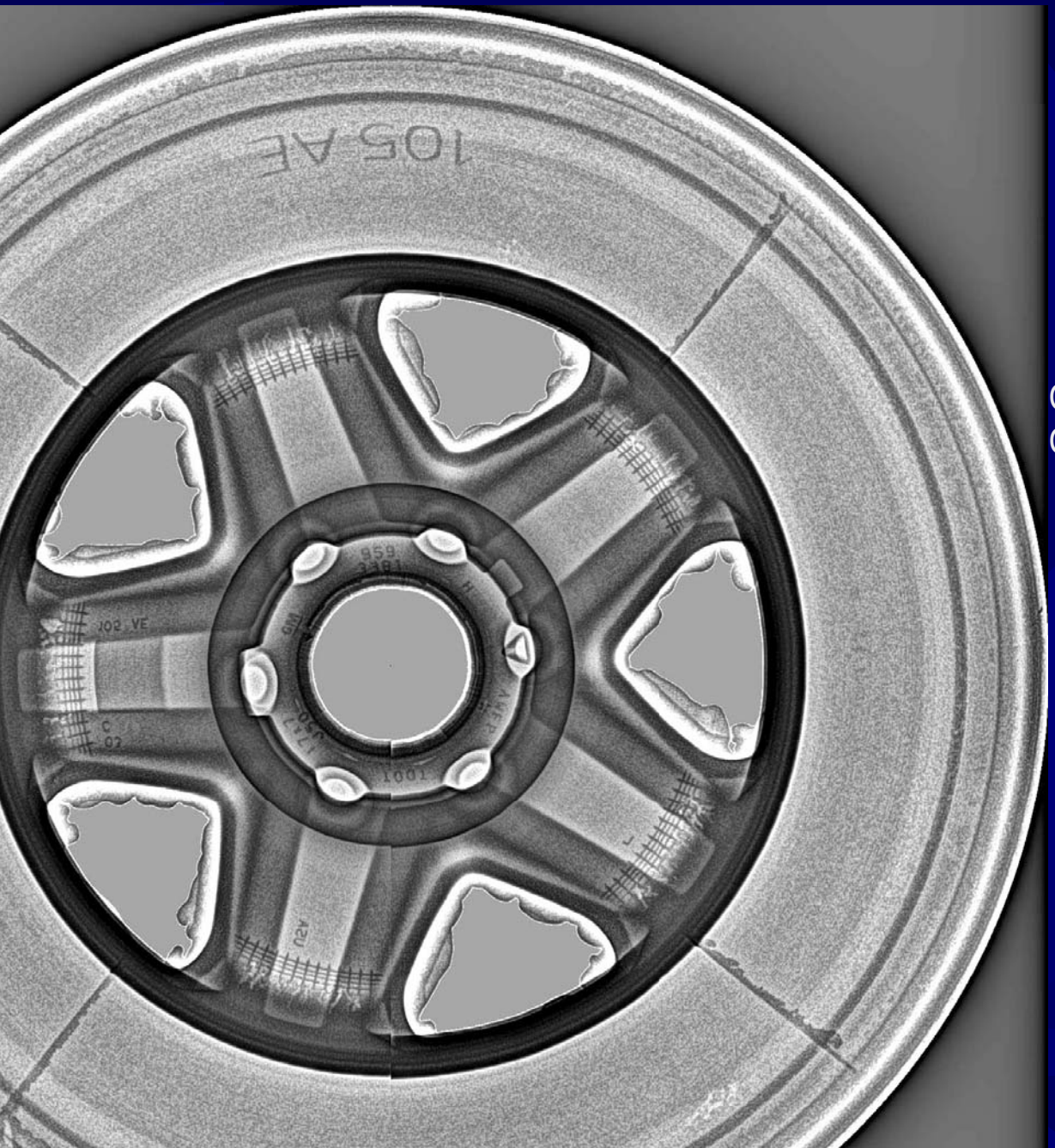
- Modern X-ray imaging systems produce digital images
- This enables sophisticated image processing to be applied to these images
- Image processing can reveal significant information, not easily discernible from the raw, acquired image

Need for Image Enhancement

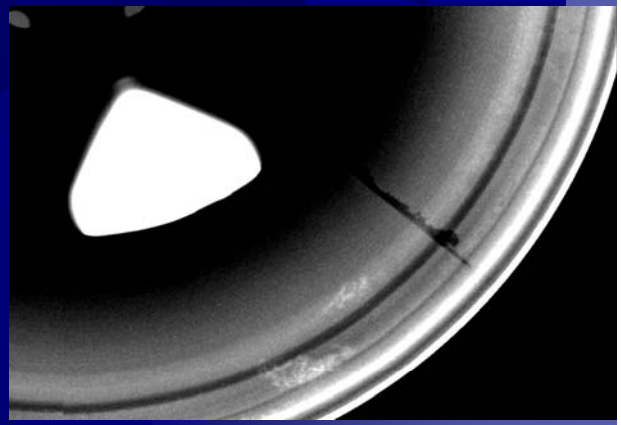
- X-ray digital detectors have high dynamic range (12-16 bits)
- Often required to detect low contrast, small sized features of interest
- Part geometry impacts viewing and interpretation
  - Makes low contrast detail difficult to detect
  - Increases inspection cycle time

Acquired

Automated Defect Enhancement (ADE)



Comparison:
Contrast-Brightness Adjustment



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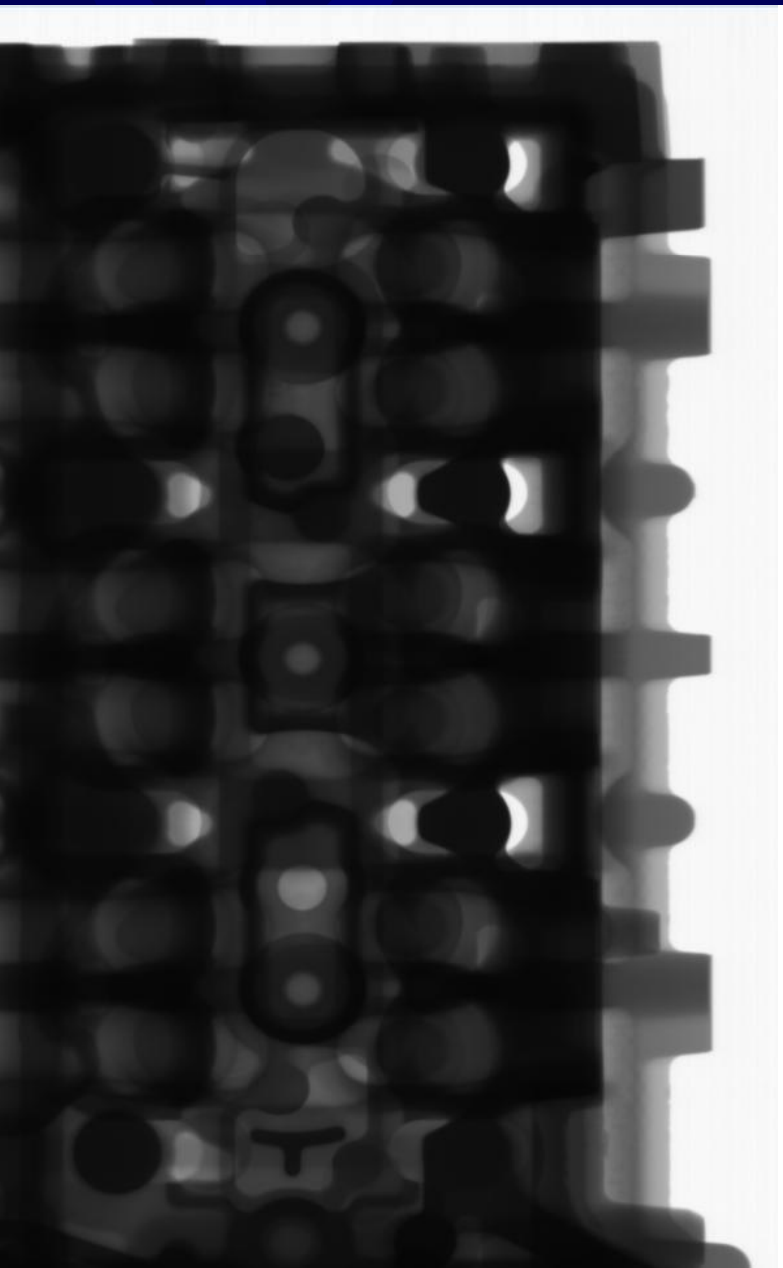
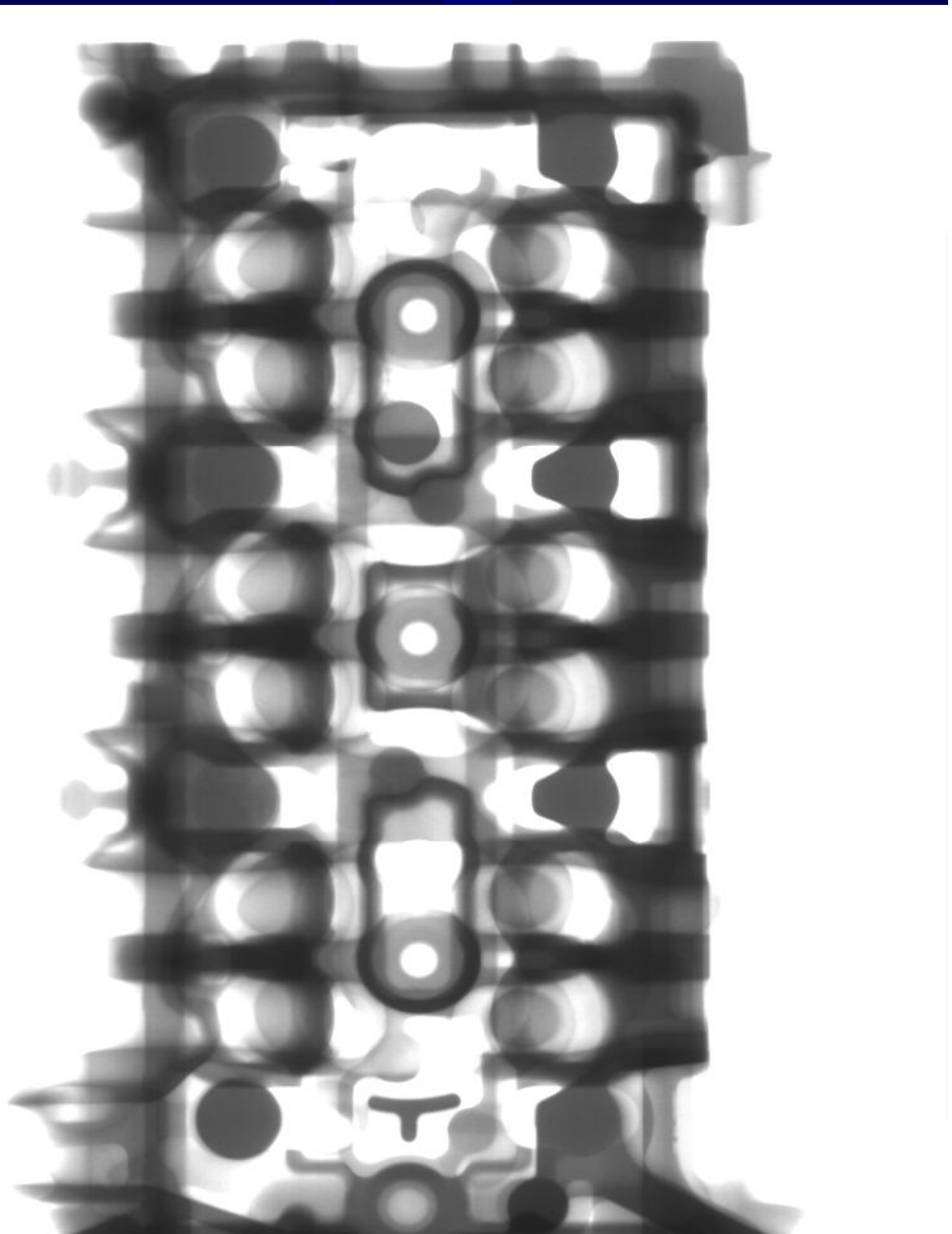
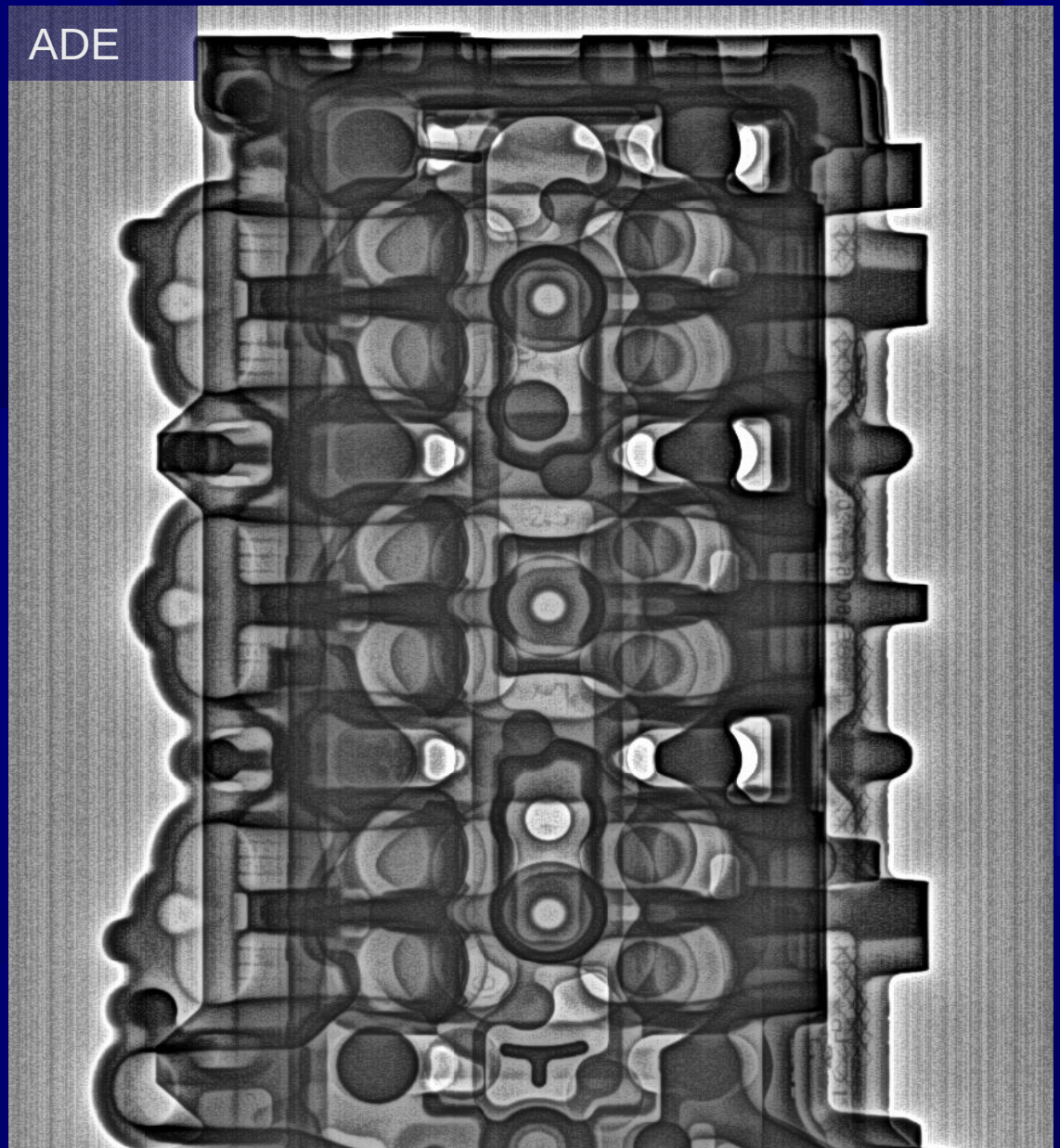
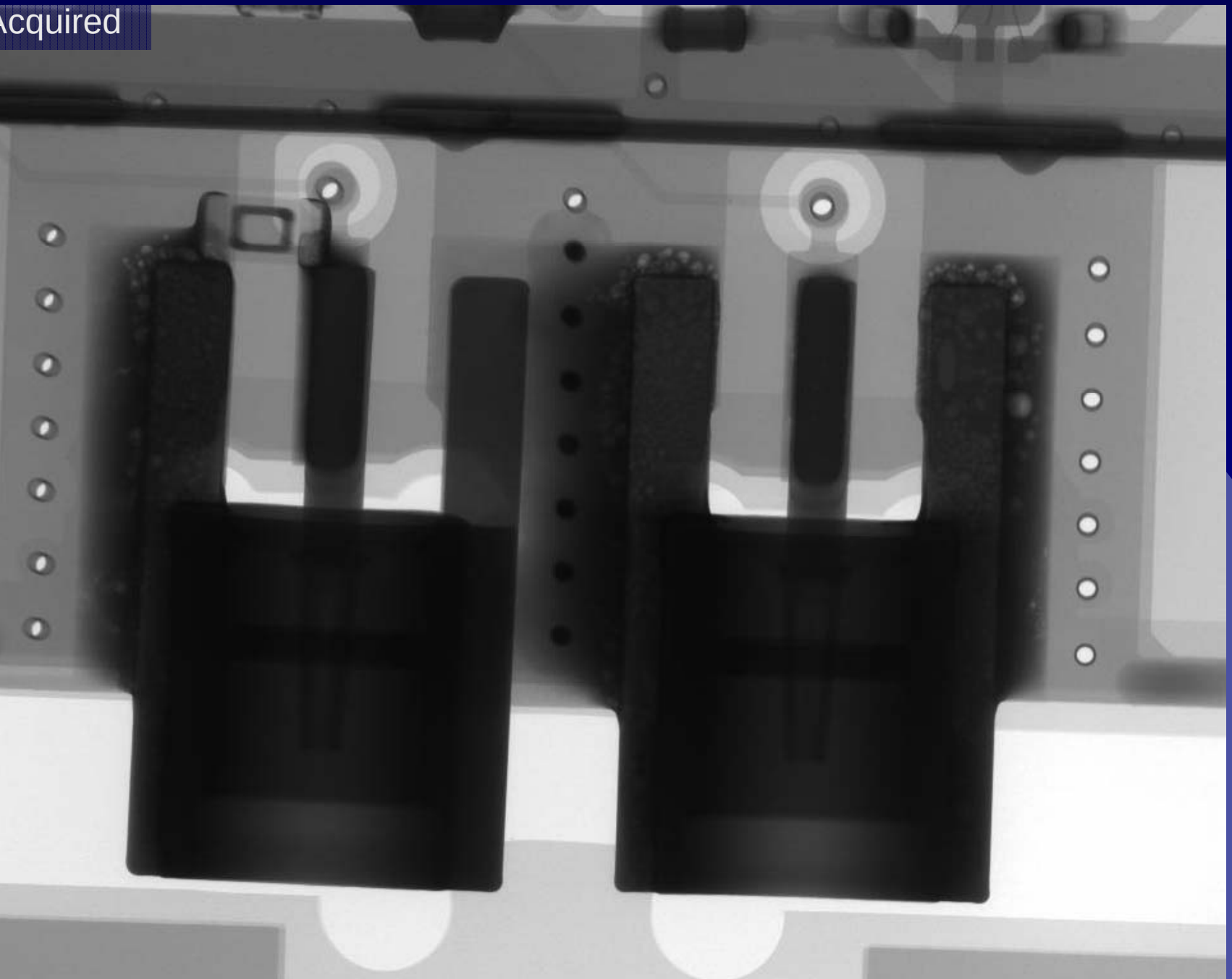


Contrast-Brightness Adjustment




ADE

Acquired



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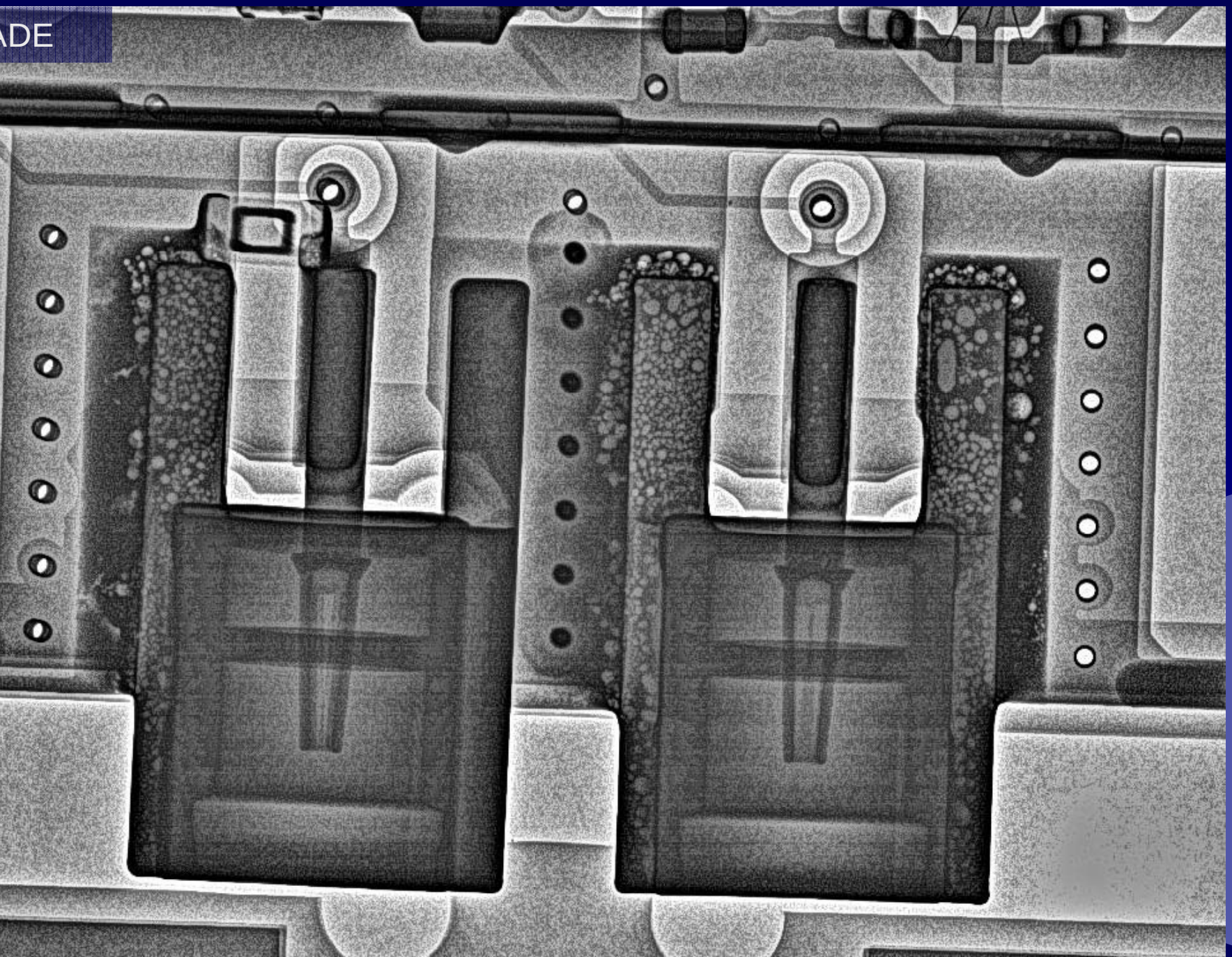
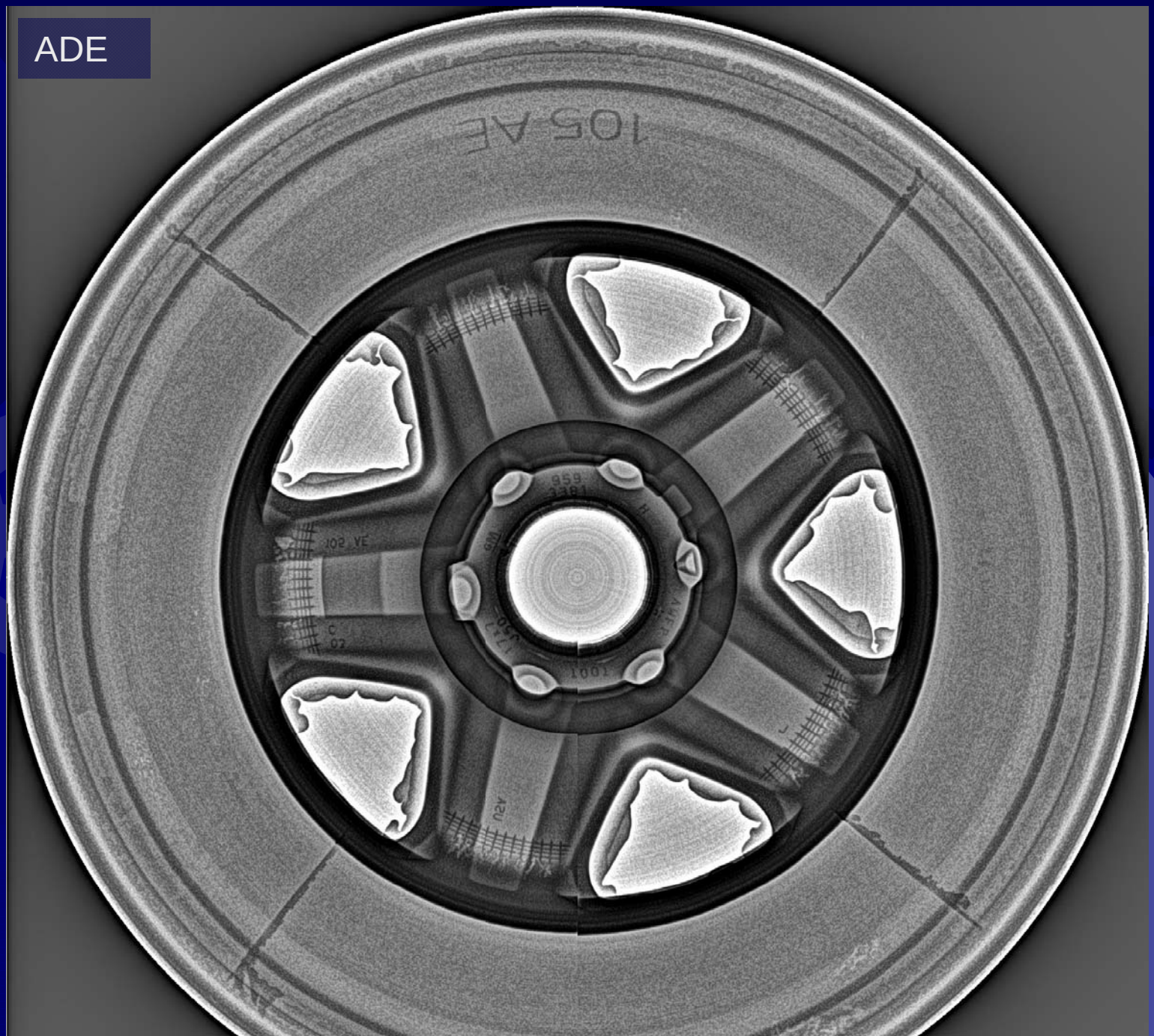


Noise Reduction

- Low contrast, fine detail enhancement also enhances noise
- Reducing noise increases contrast and detail visibility
- Challenge is to reduce noise without losing detail (detail preserving)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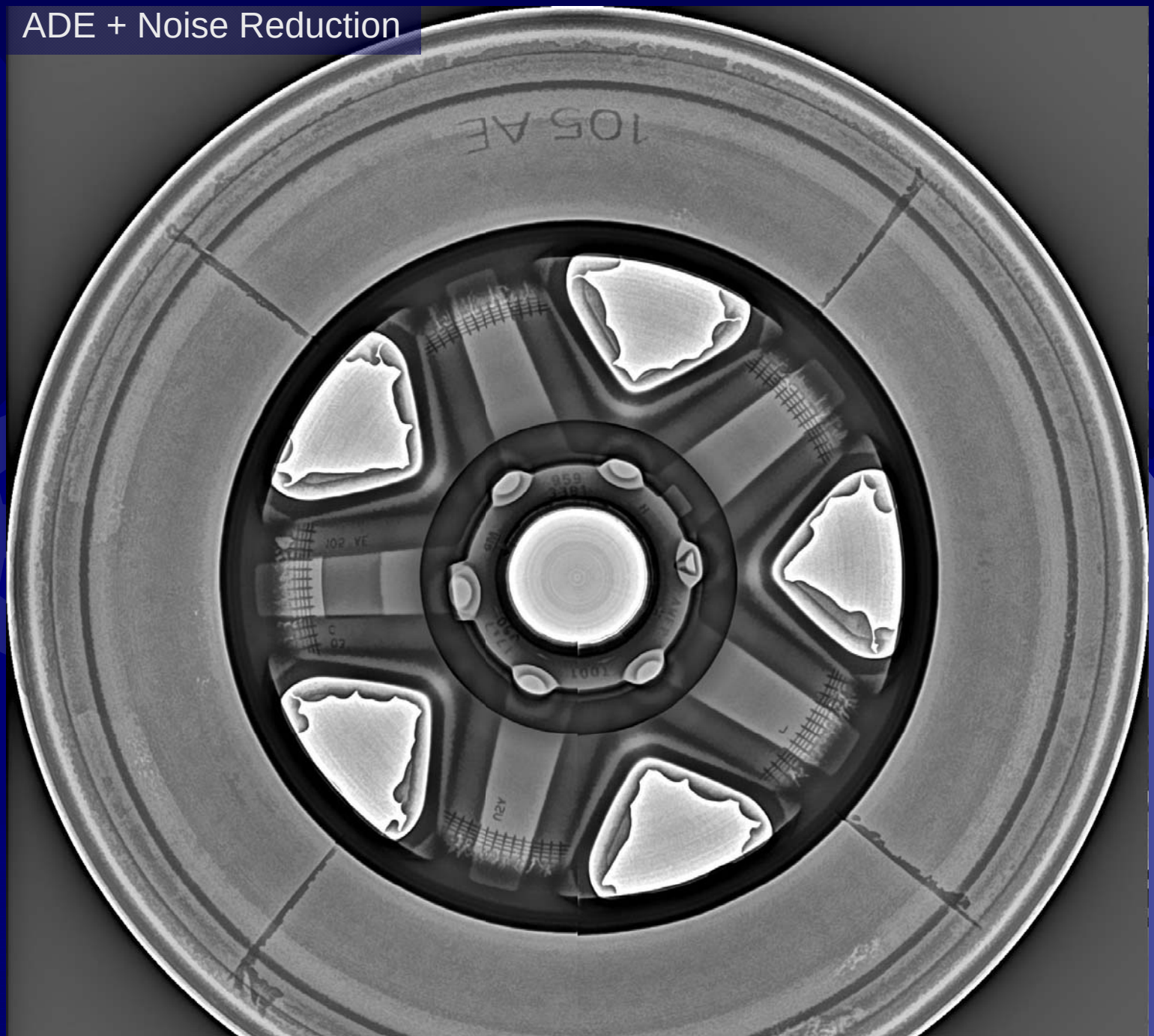
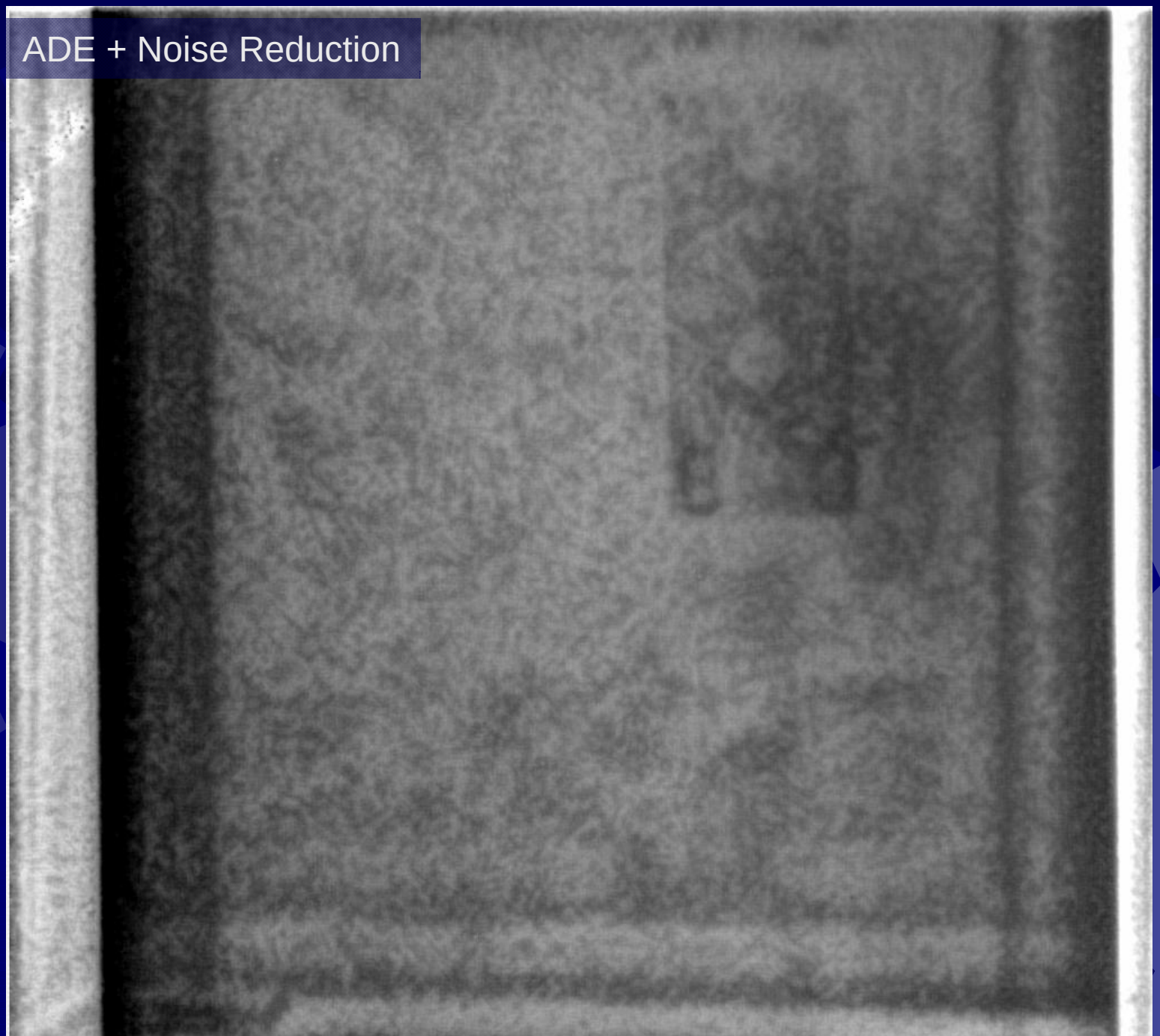
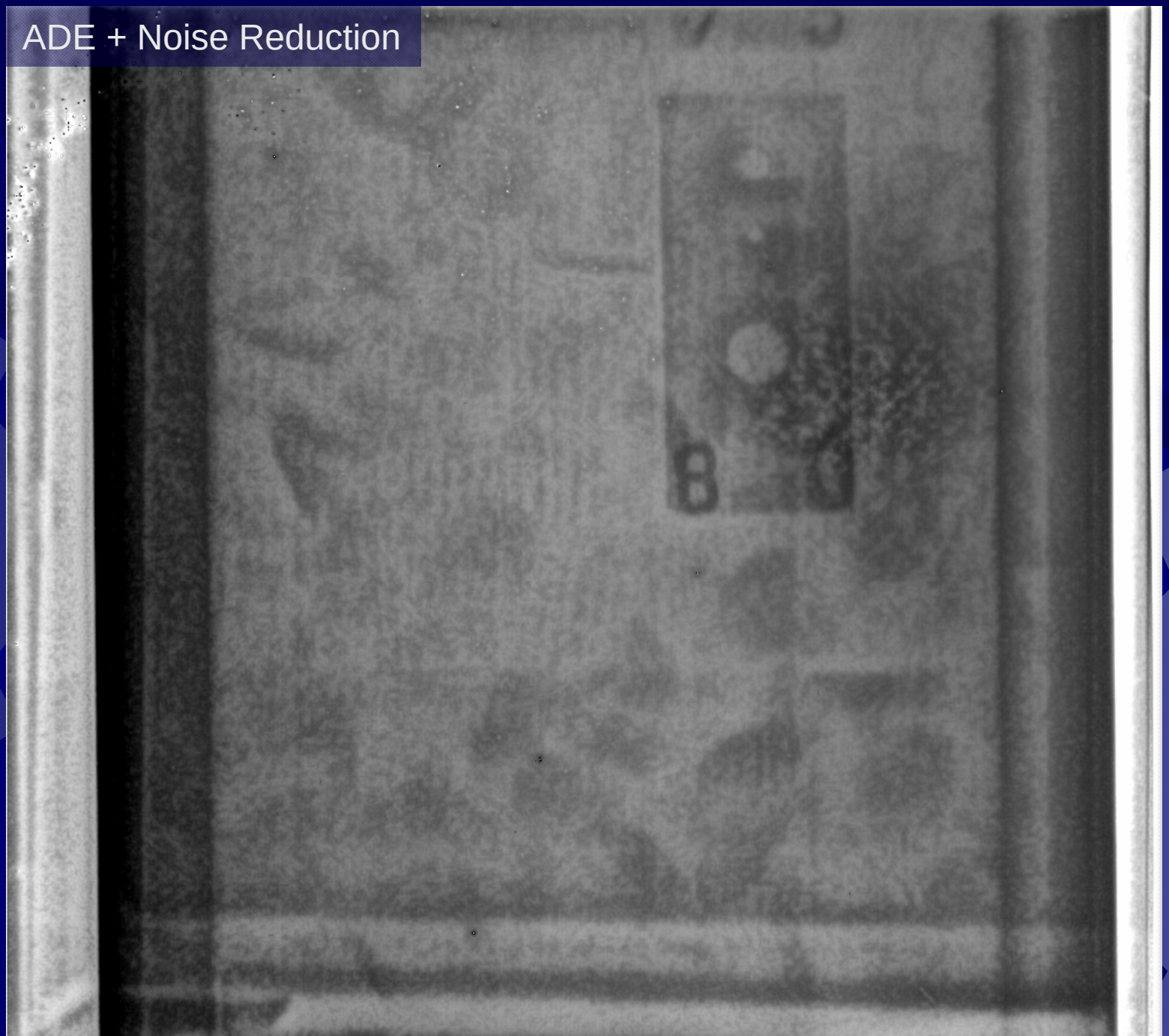

ADE + Noise Reduction

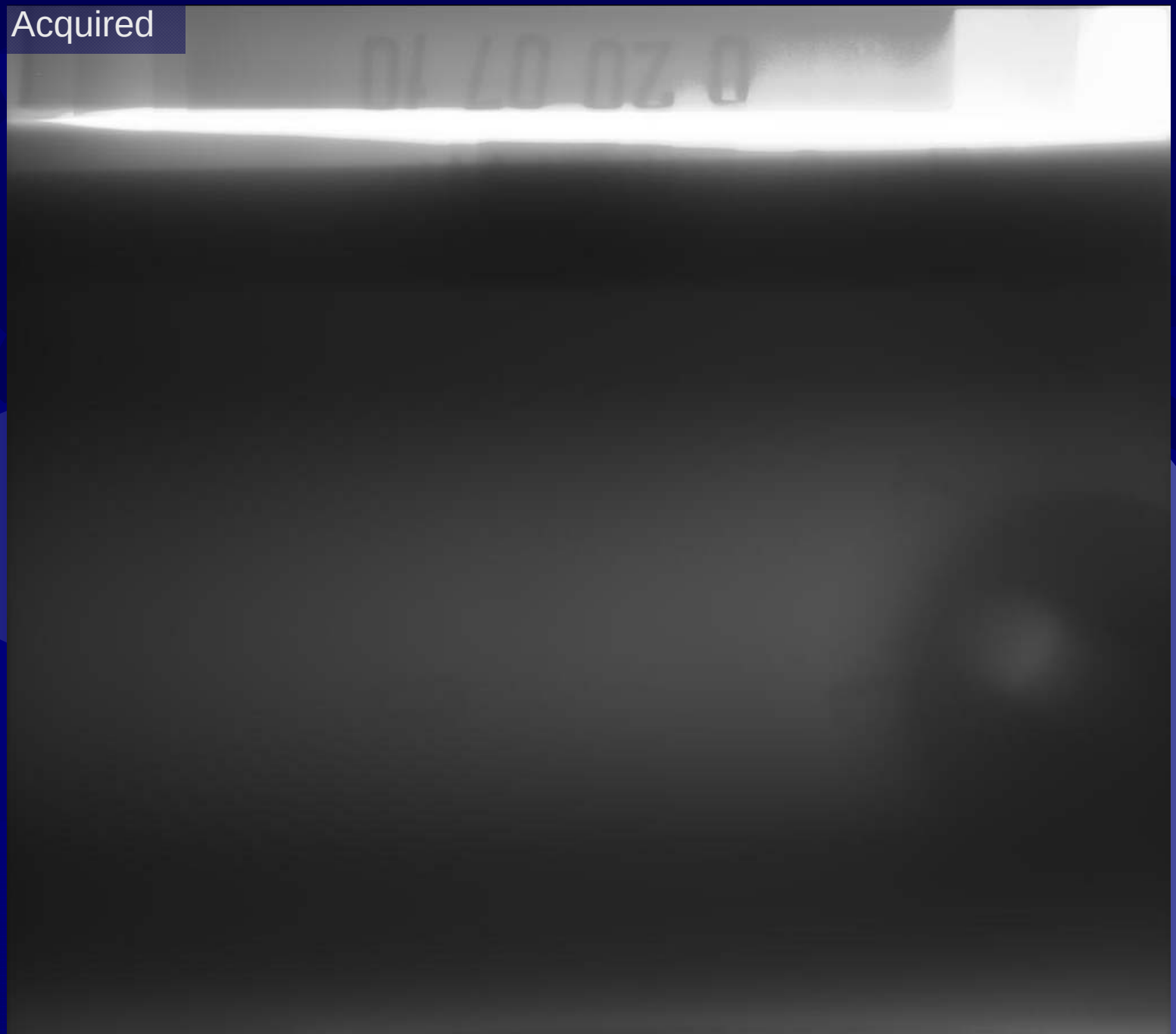
Acquired

ADE


ADE + Noise Reduction

ADE


ADE + Noise Reduction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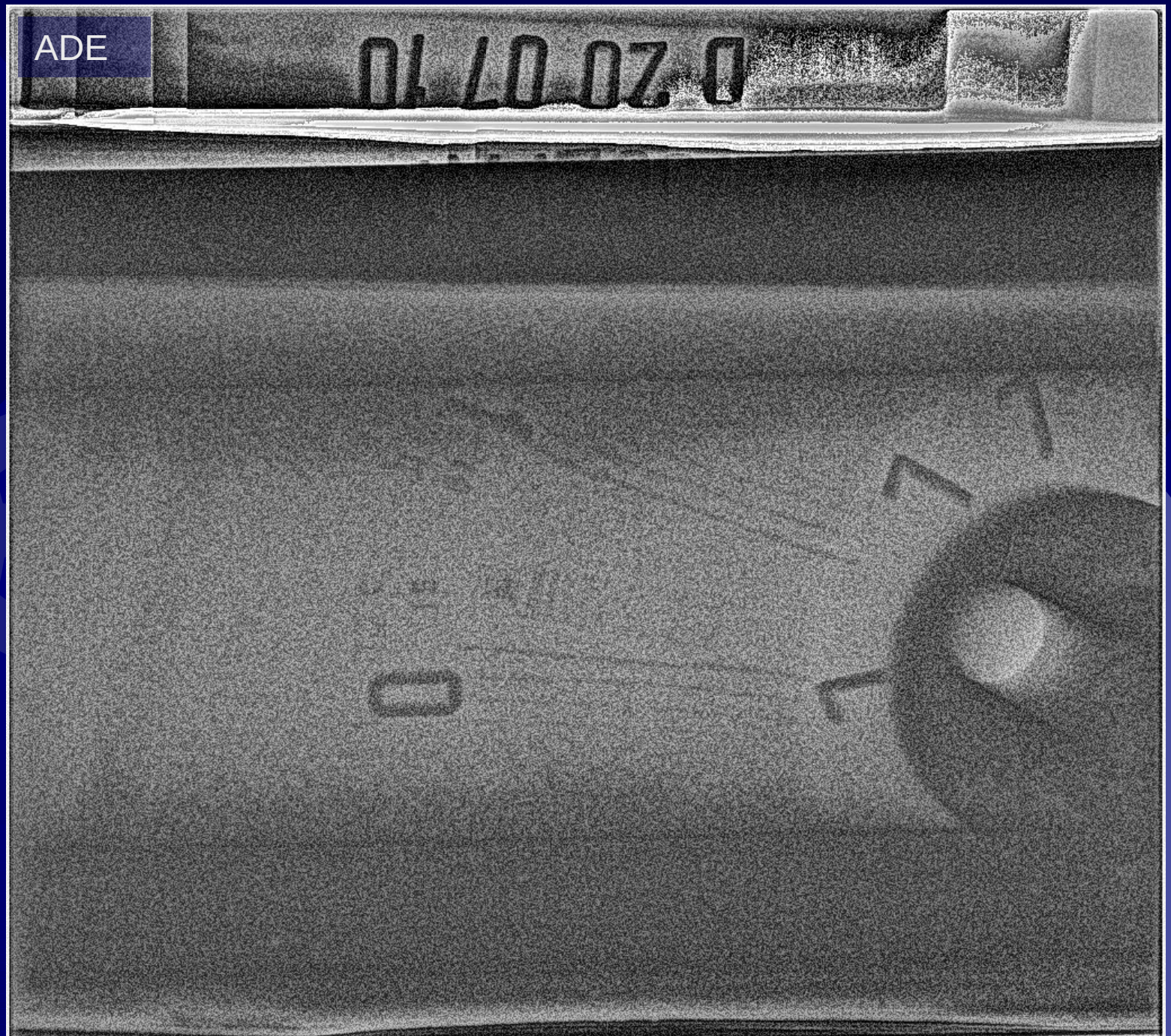
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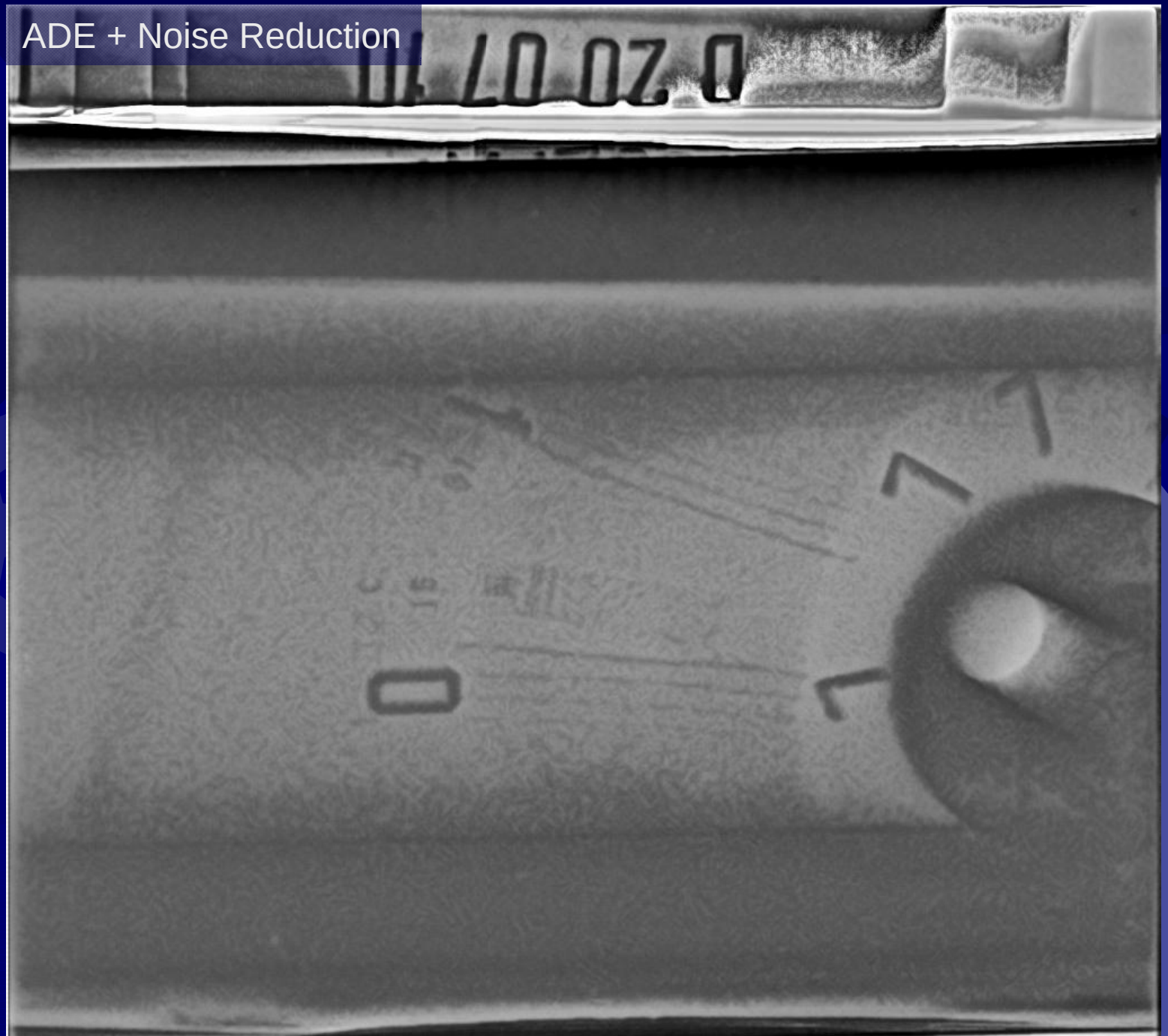
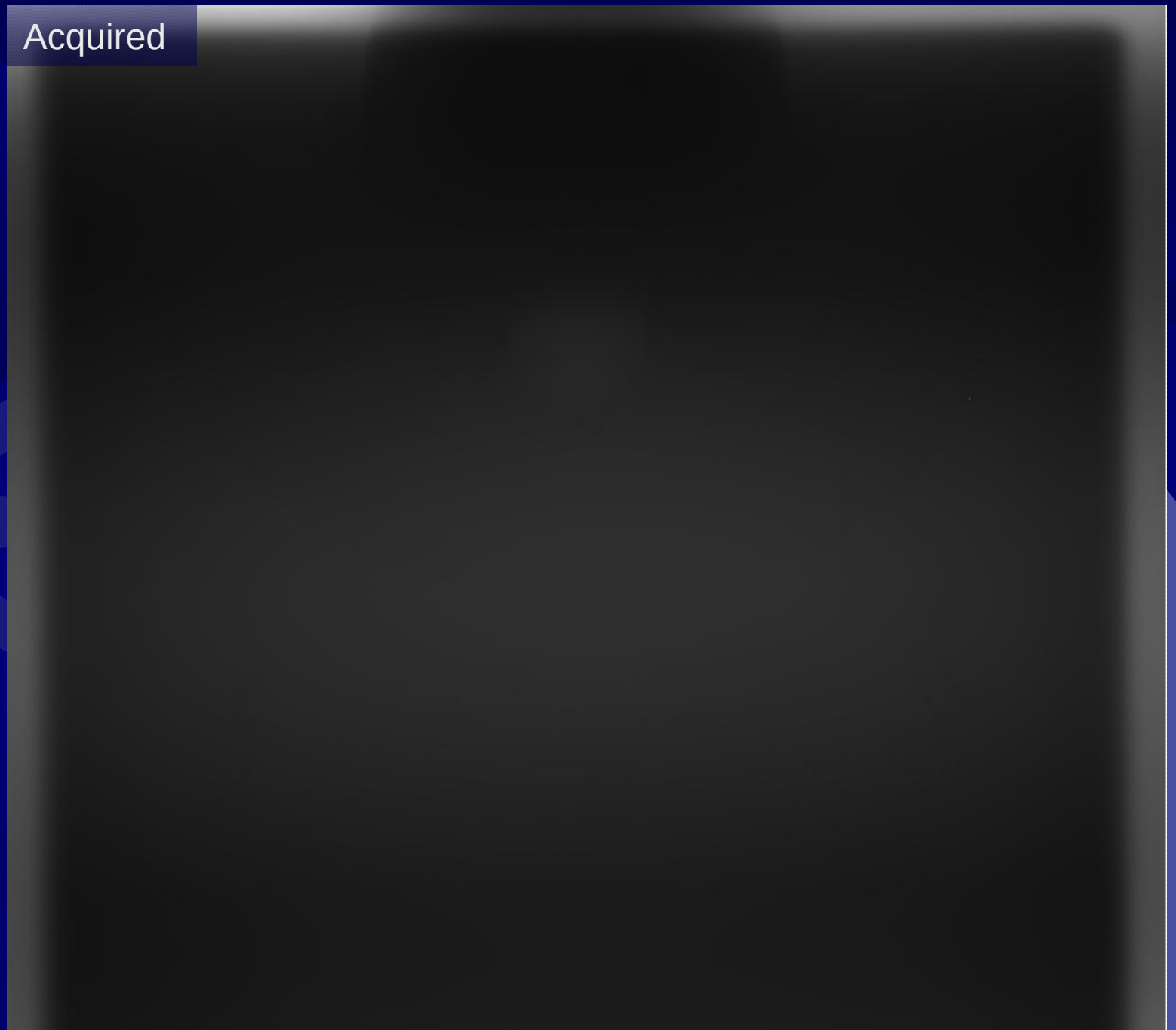
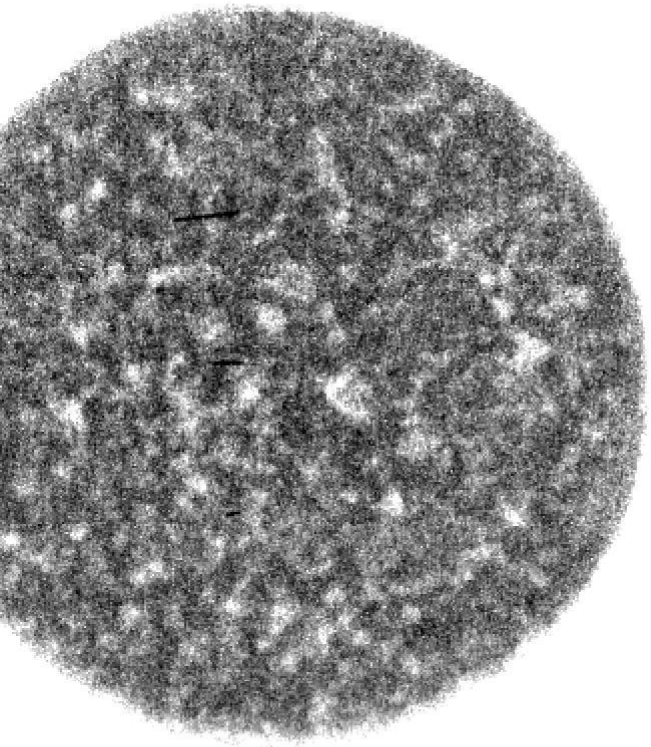

ADE + Noise Reduction


Acquired

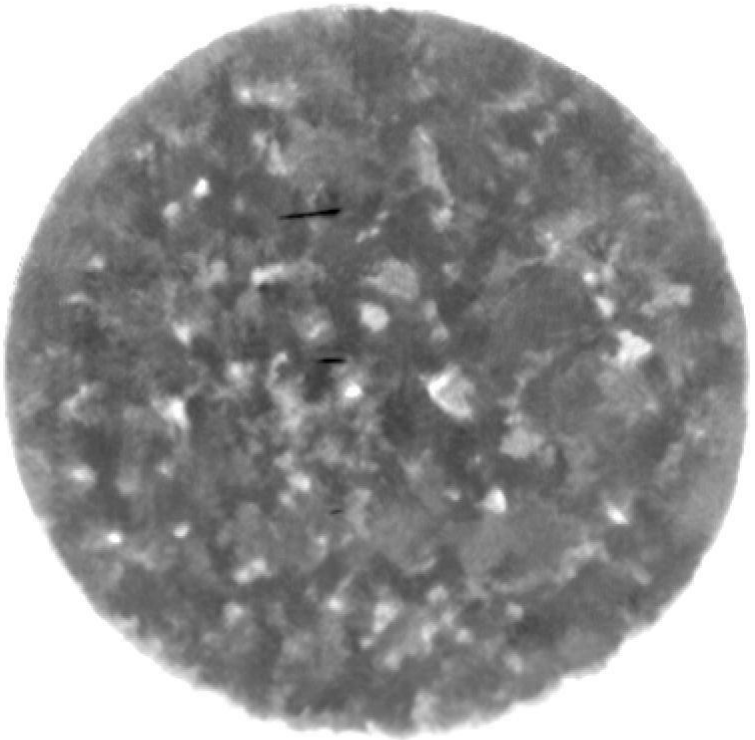
ADE

ADE + Noise Reduction

+ Contrast-Brightness
nt

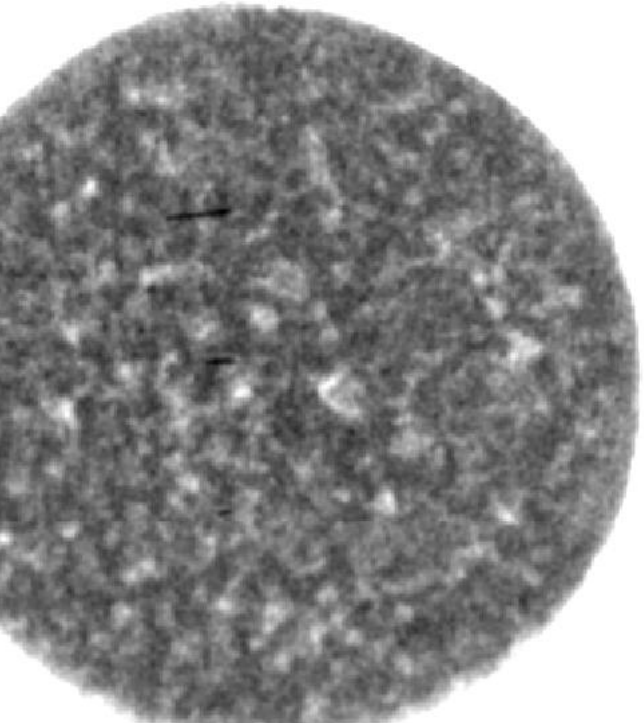


Acquired + Noise Reduction +
Contrast-Brightness Adjustment

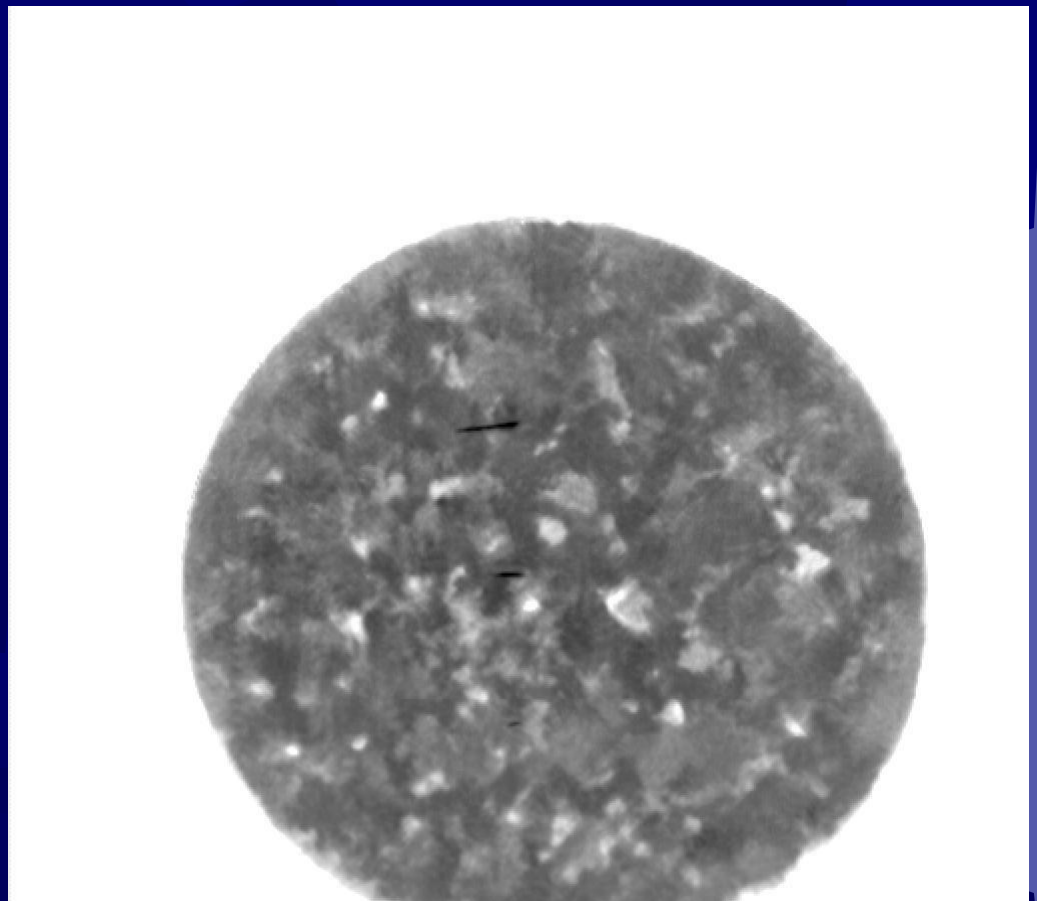


Comparison (Gaussian filter)

d + Gaussian smoothen (1) +
t-Brightness Adjustment



Acquired + Noise Reduction +
Contrast-Brightness Adjustment



Comparison (Gaussian filter)

d + Gaussian smoothen (2) +
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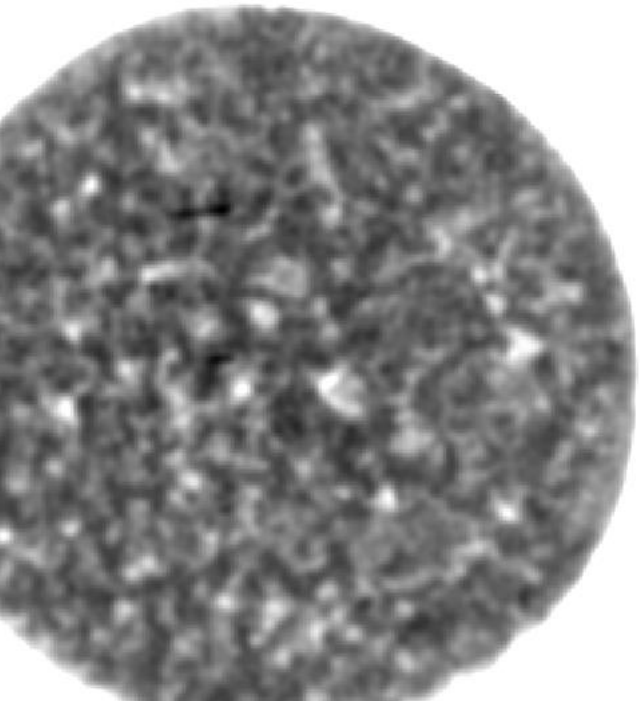
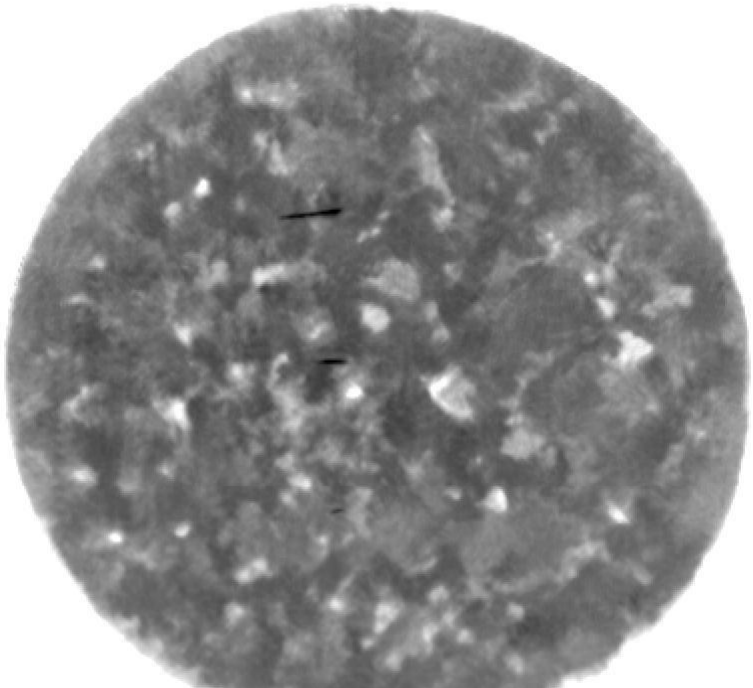
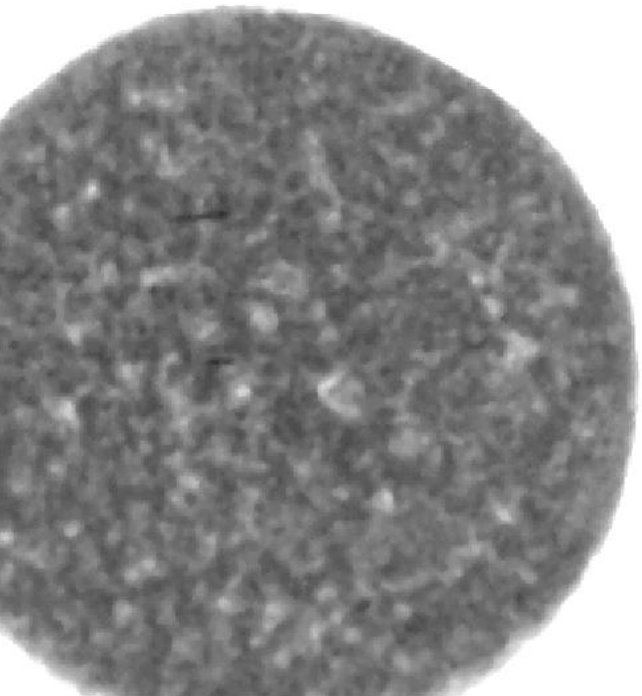


Acquired + Noise Reduction +
Contrast-Brightness Adjustment

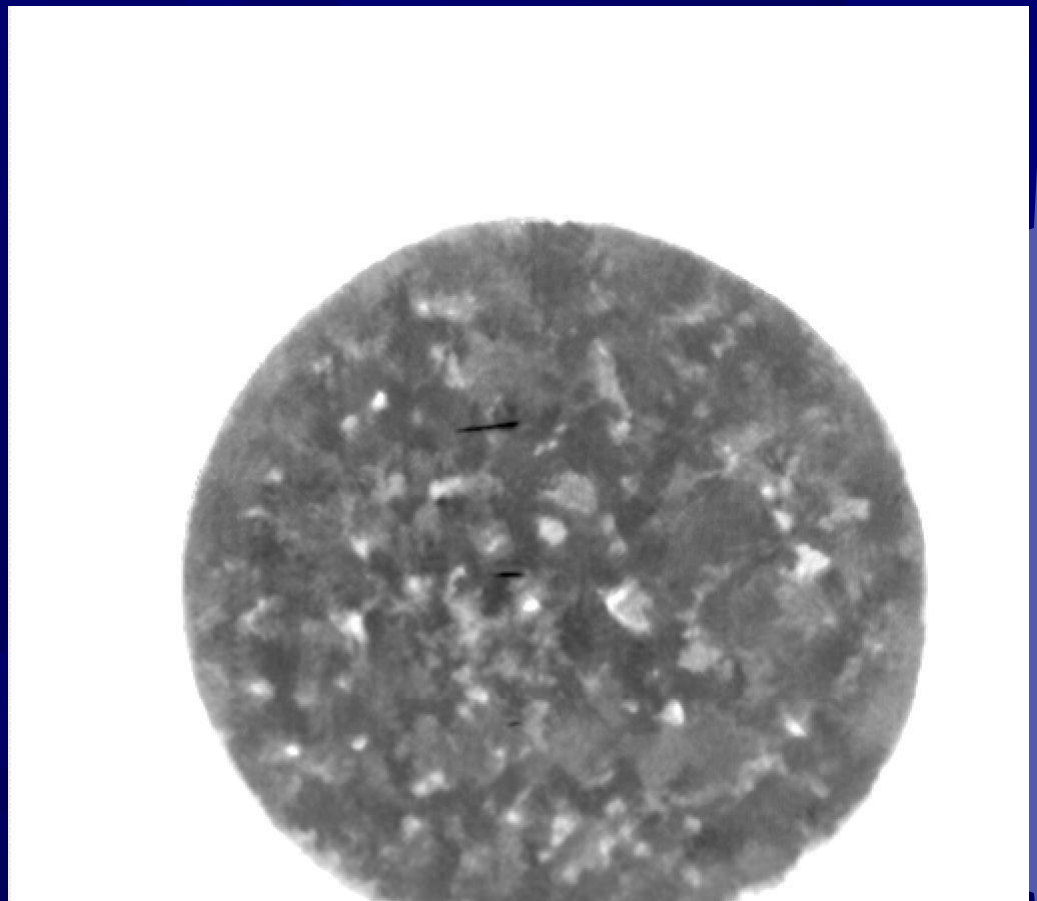


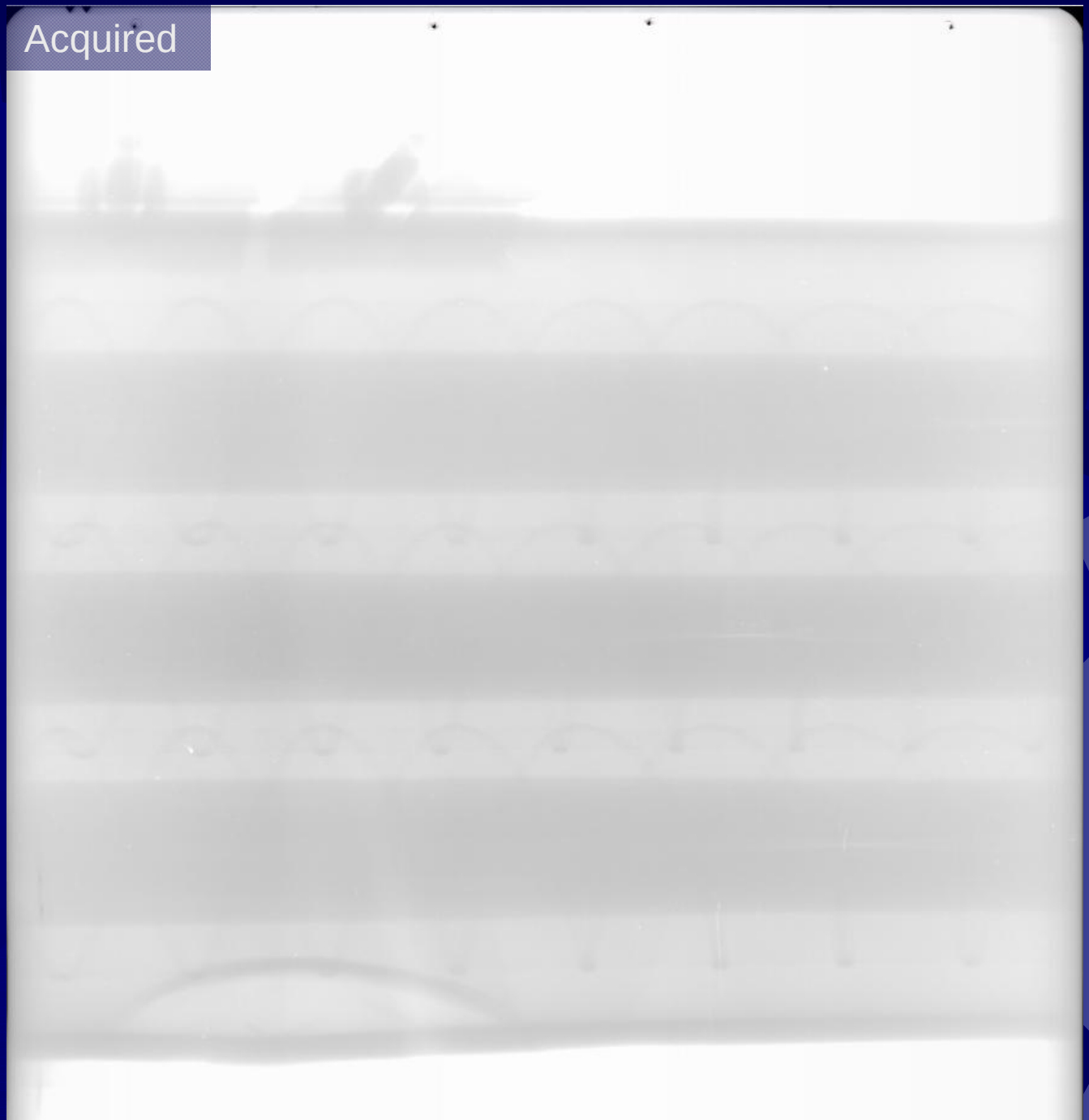
Comparison (Median filter)

d + Median filter + Contrast-
ess Adjustment



Acquired + Noise Reduction +
Contrast-Brightness Adjustment

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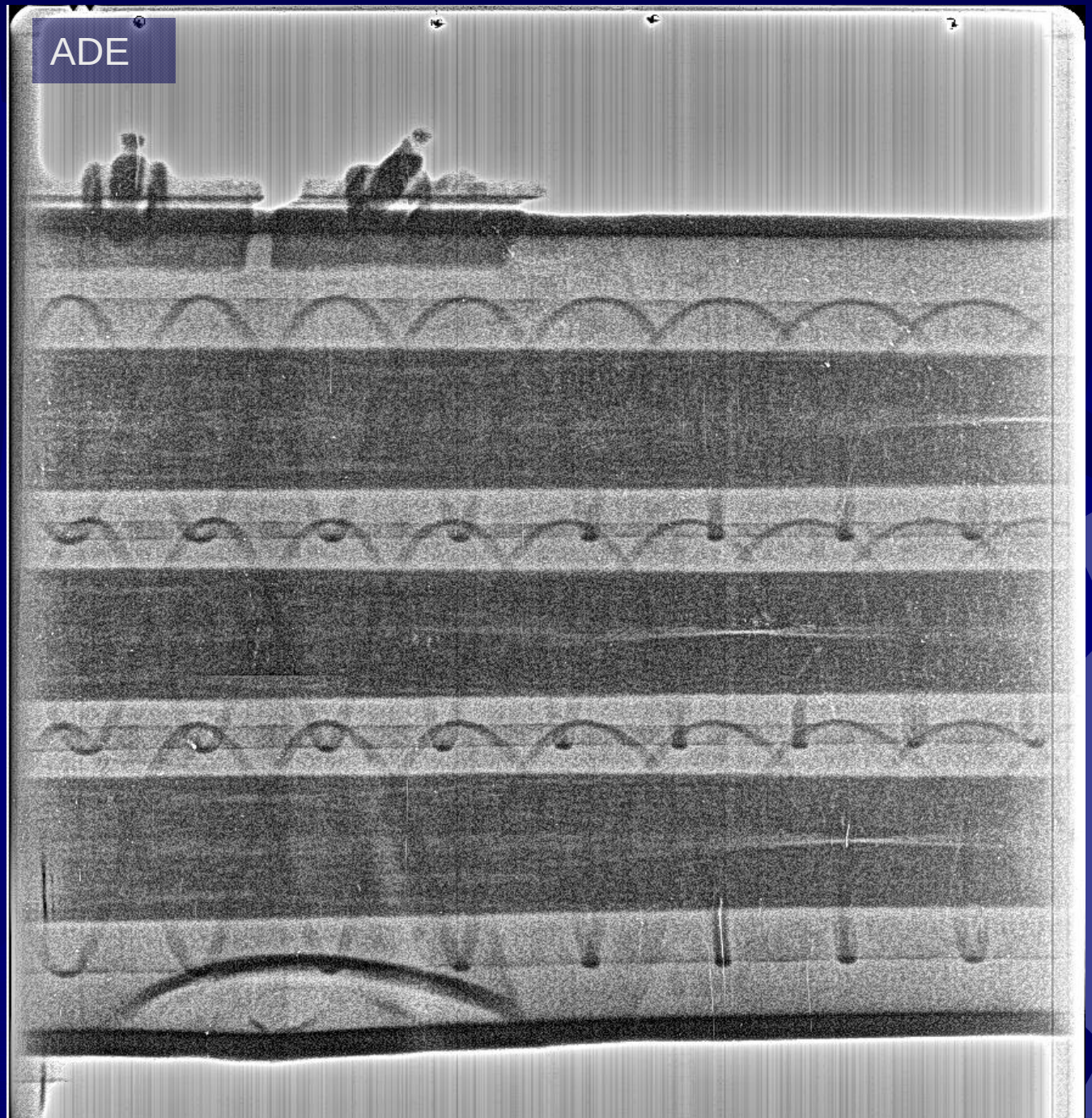
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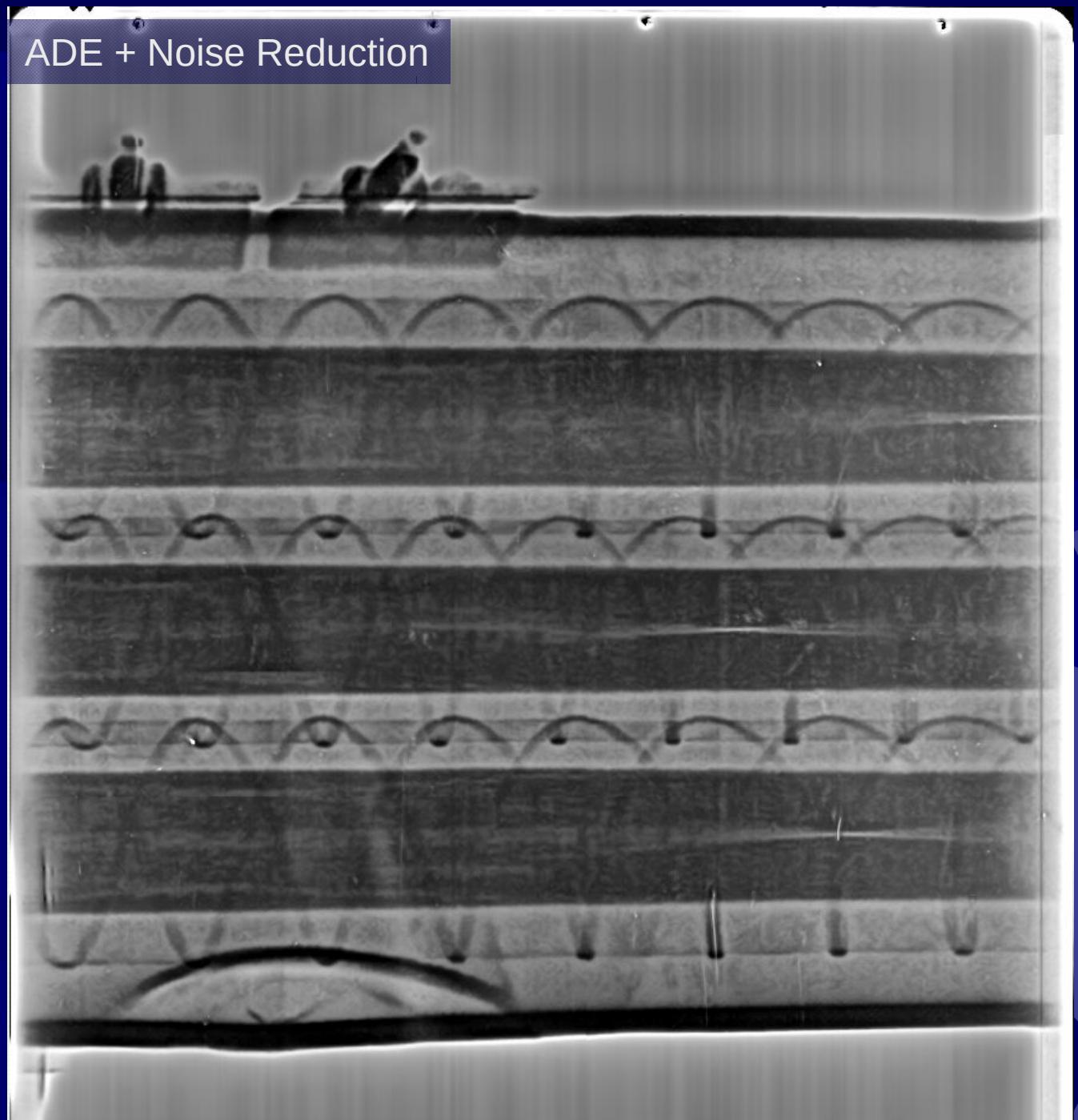
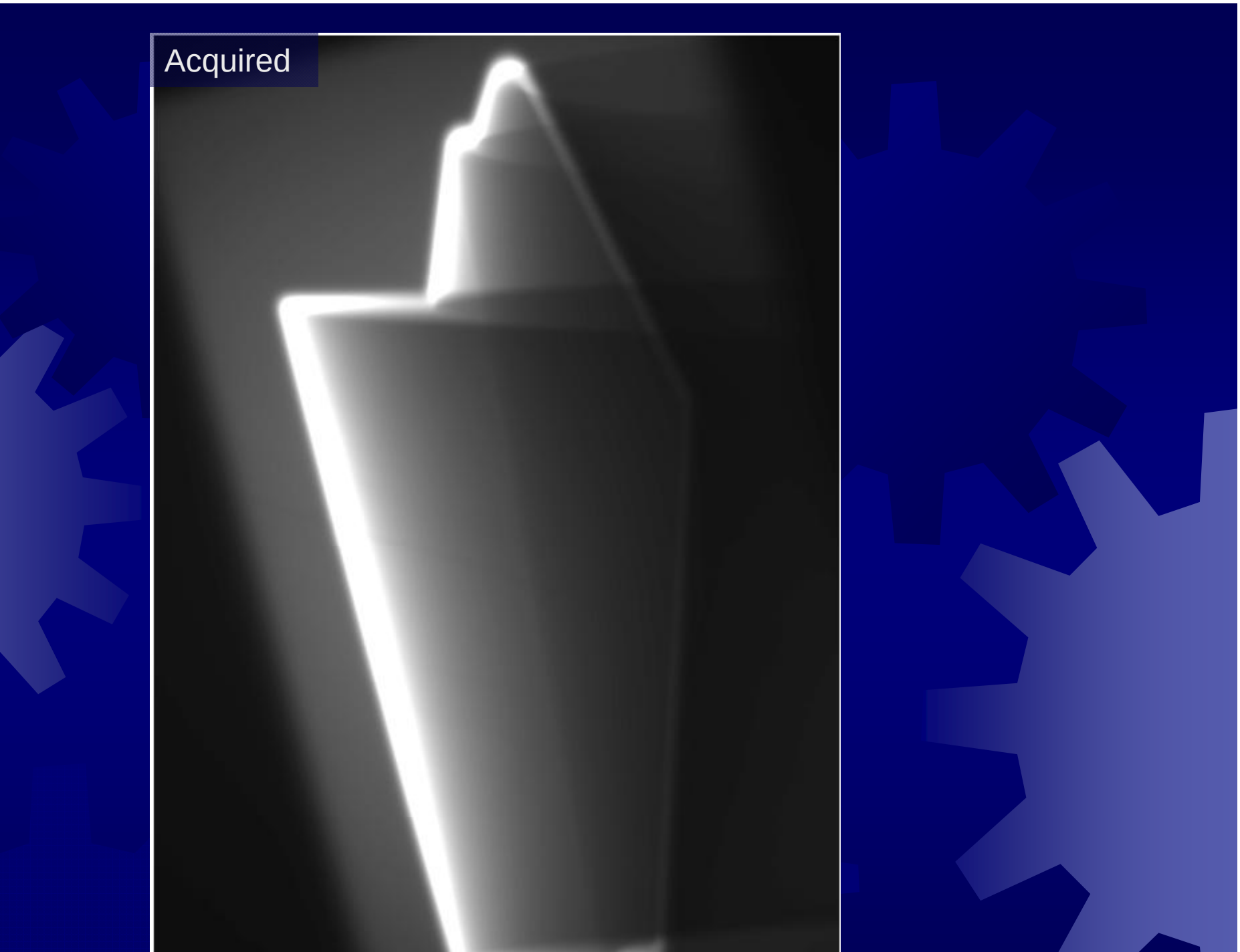

ADE + Noise Reduction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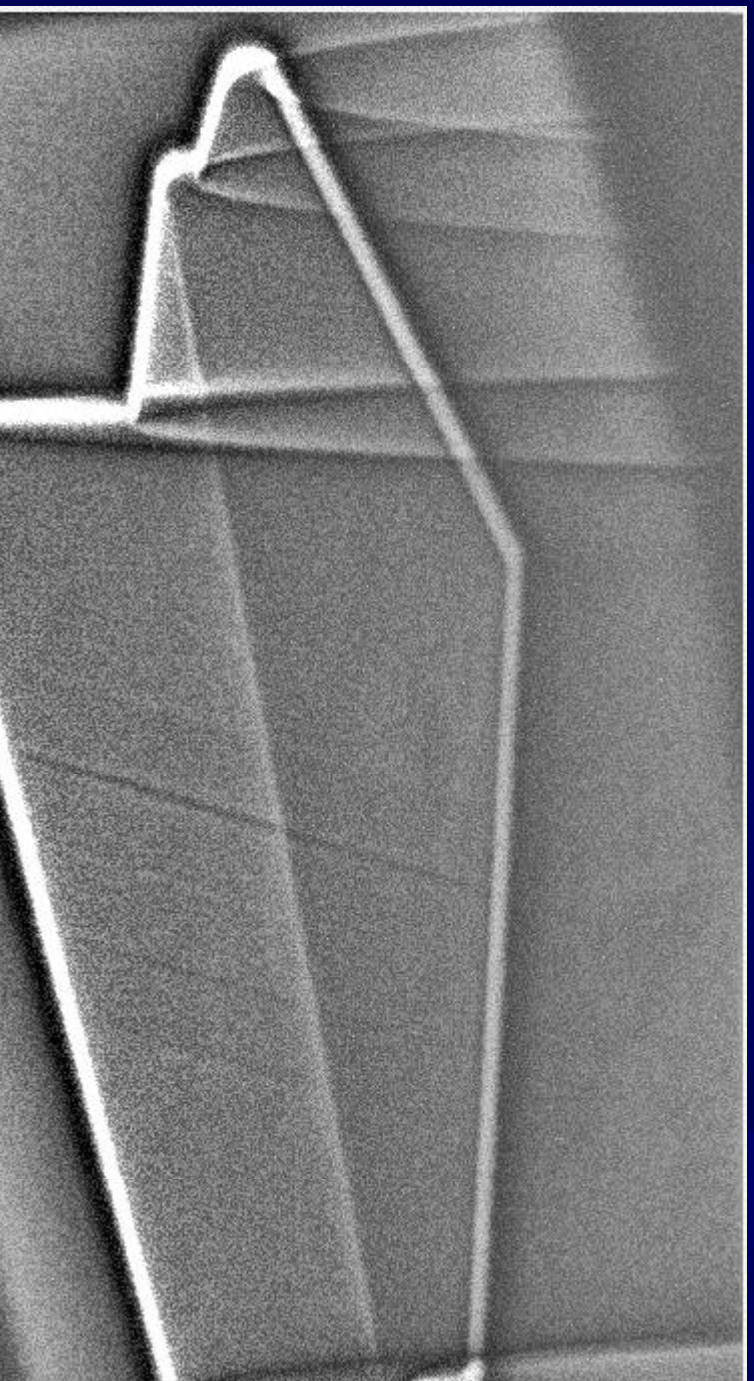

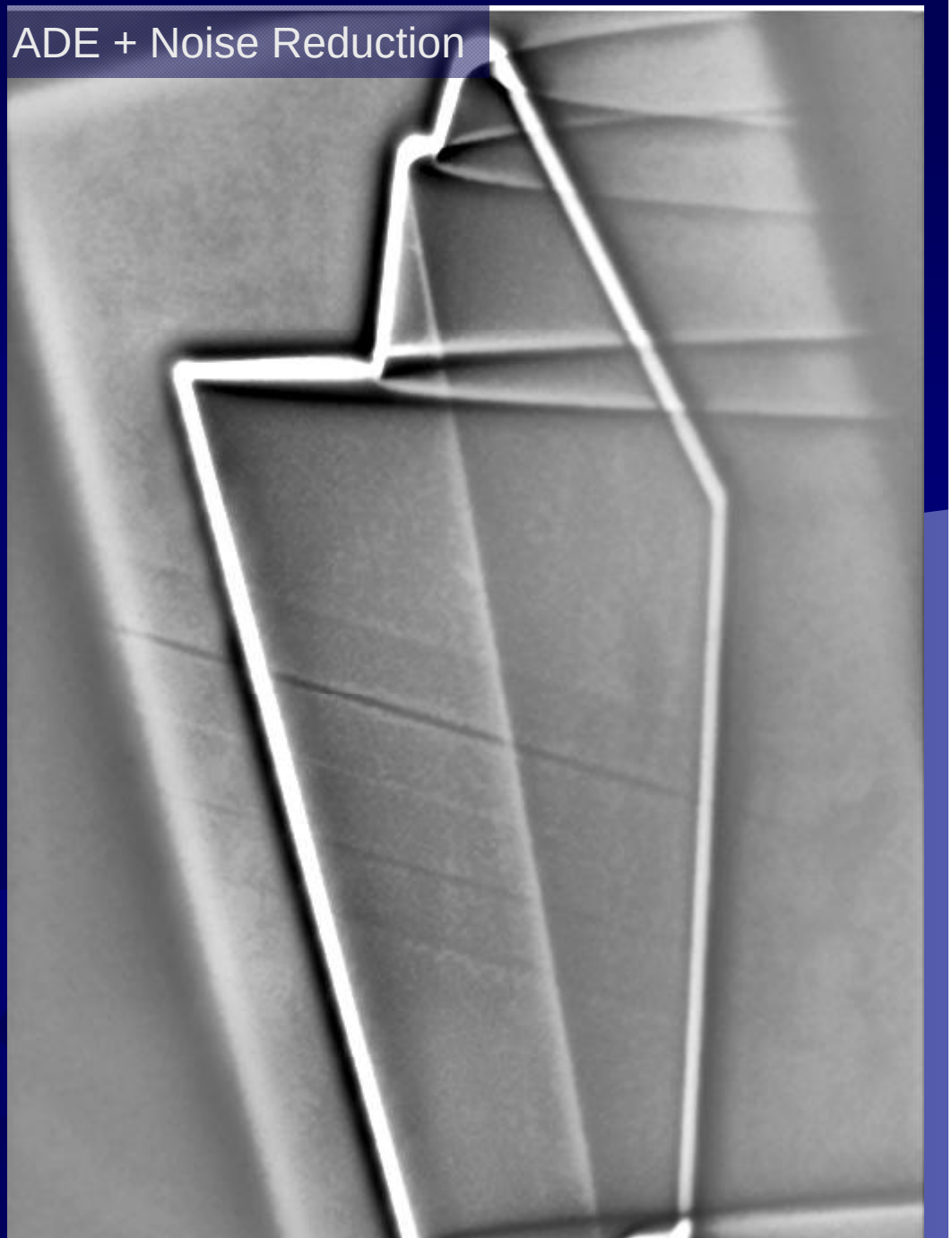
ADE + Noise Reduction

Special Filters

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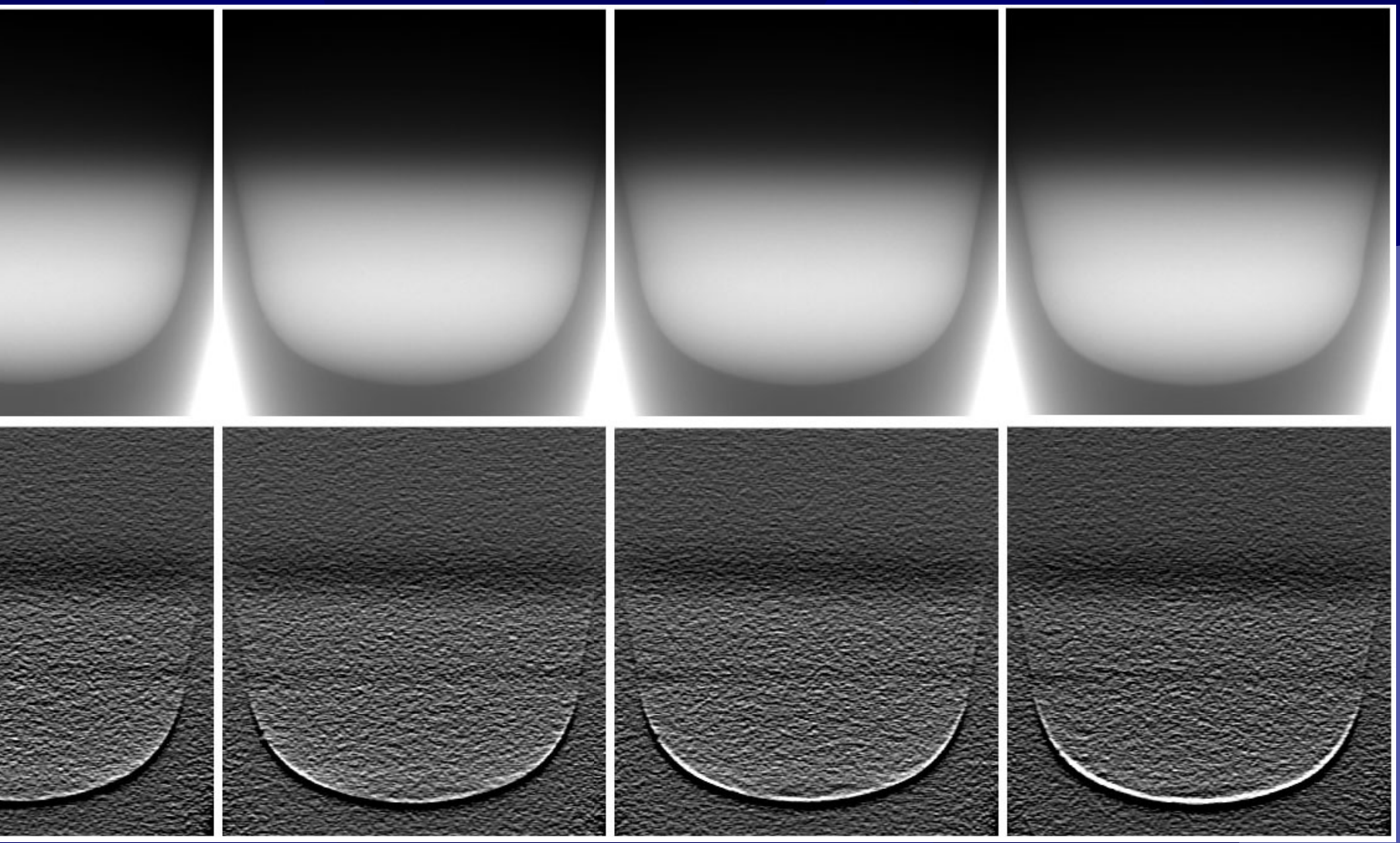
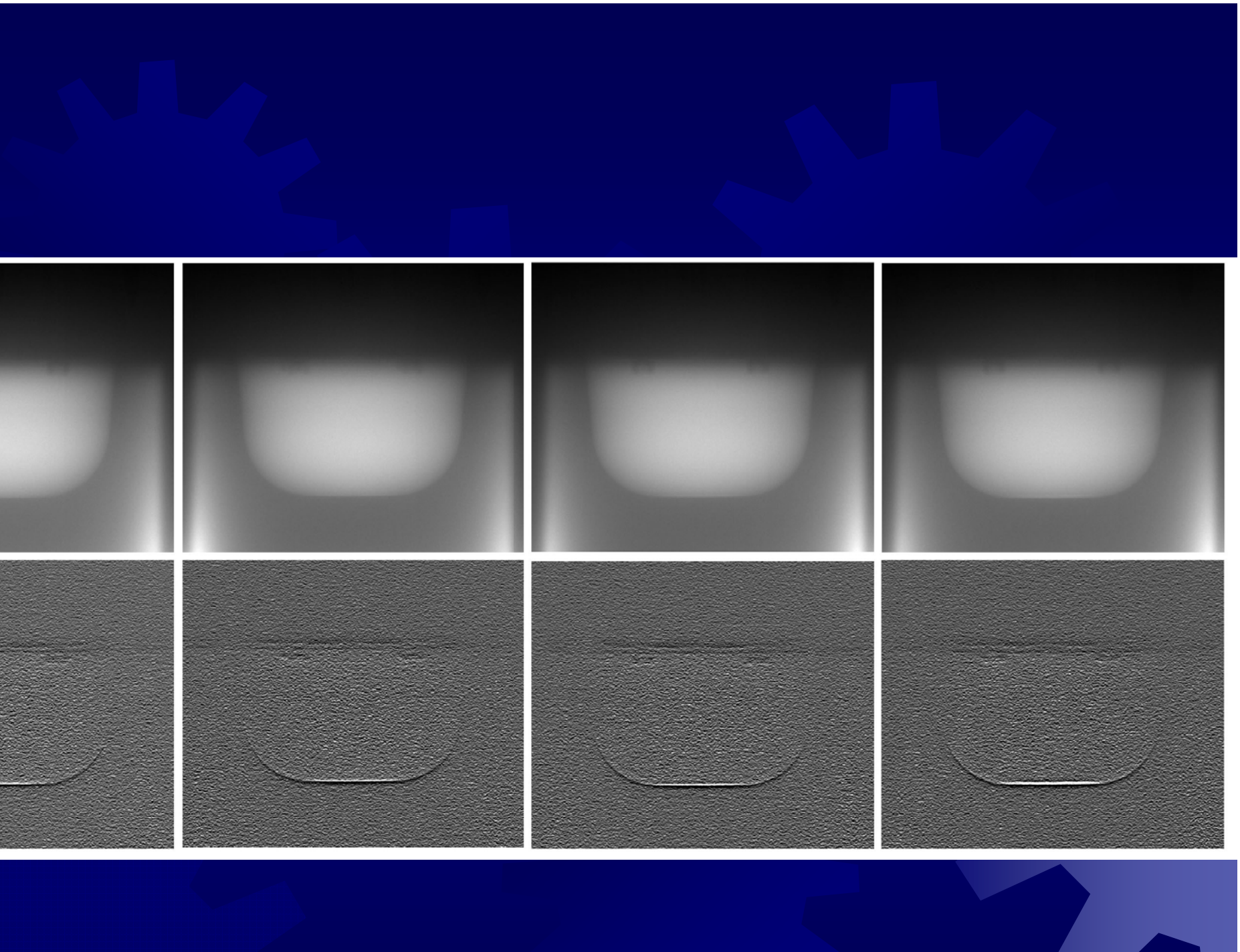
31 OCT 05
#52930197 I3 SC 06 I-14

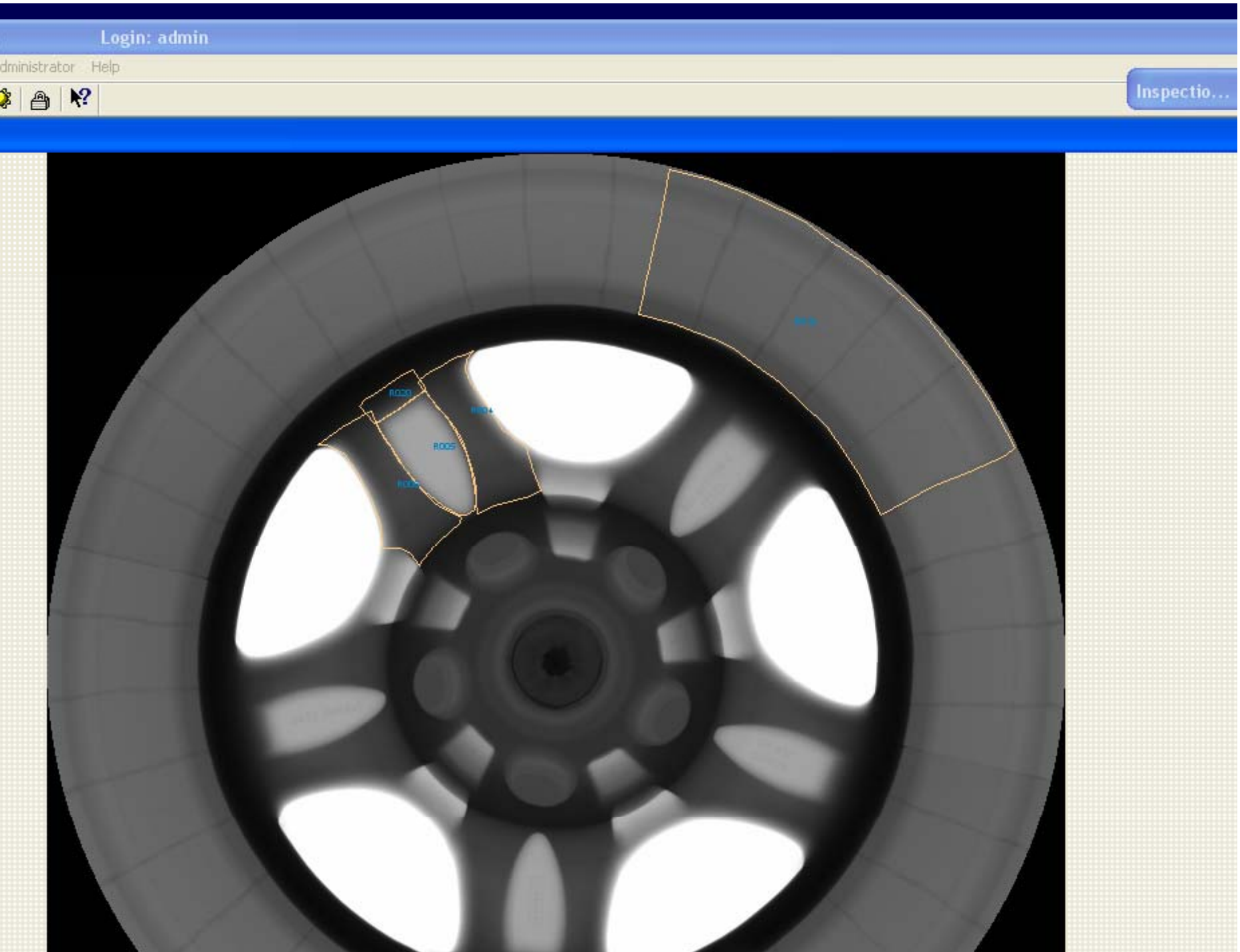
GM 6.2L P/5071
31 OCT 05
#52930197 I3 SC 06 I-14





mage Registration

- Image registration is the process of aligning images to relate corresponding features
- Application primarily in Automated X-Ray Inspection
- Methods
  - Invariant Feature Correspondence (Fiducials)
  - Optical Flow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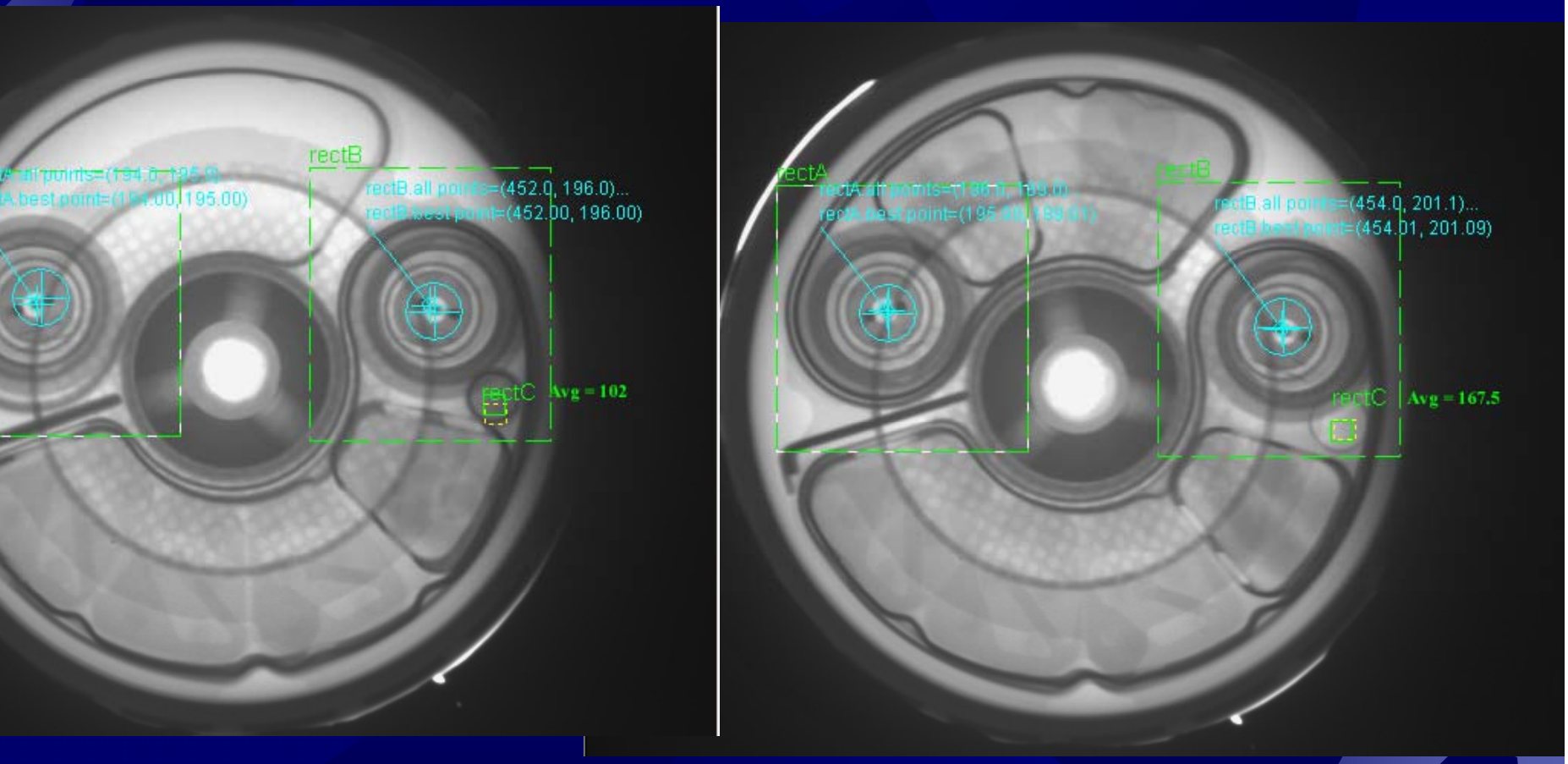
R010

Air-Bag Inflators

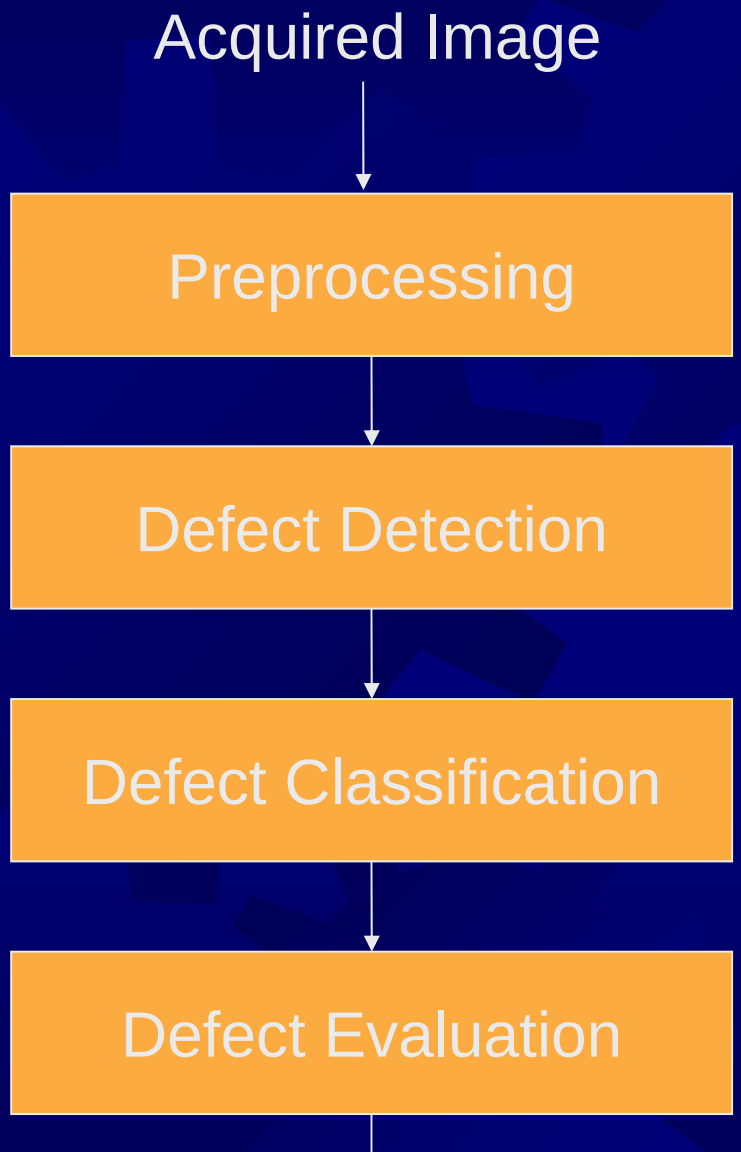
Auto-Ignition Cartridge Verification



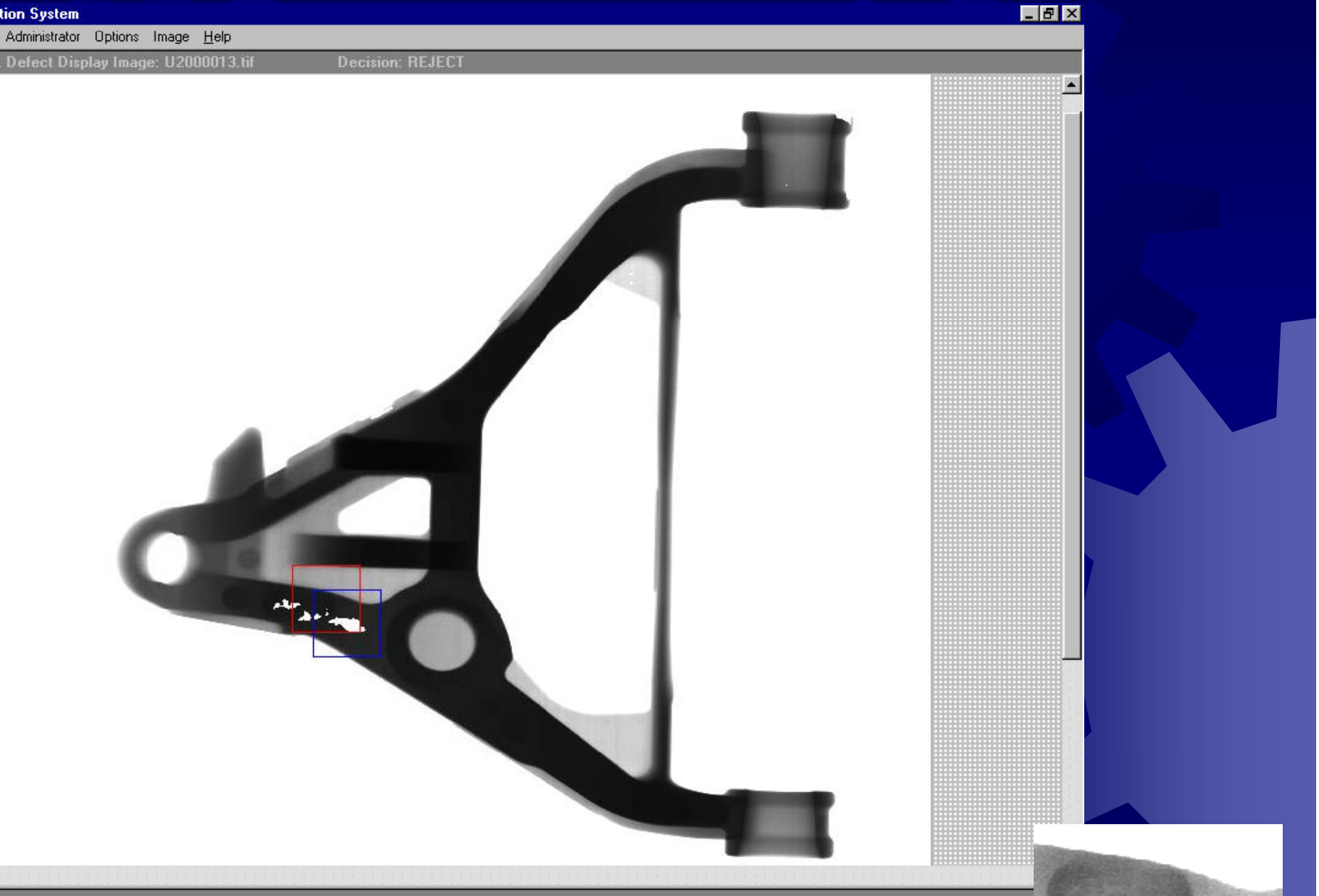
Automated Defect Recognition (ADR)

- Fully automated X-ray image analysis done by computer
- Automatic, semi-automatic and operator assist modes
- Automatic part identification (ability to inspect different part types in random order)

utomated Defect Recognition
ADR)



mated Defect Recognition



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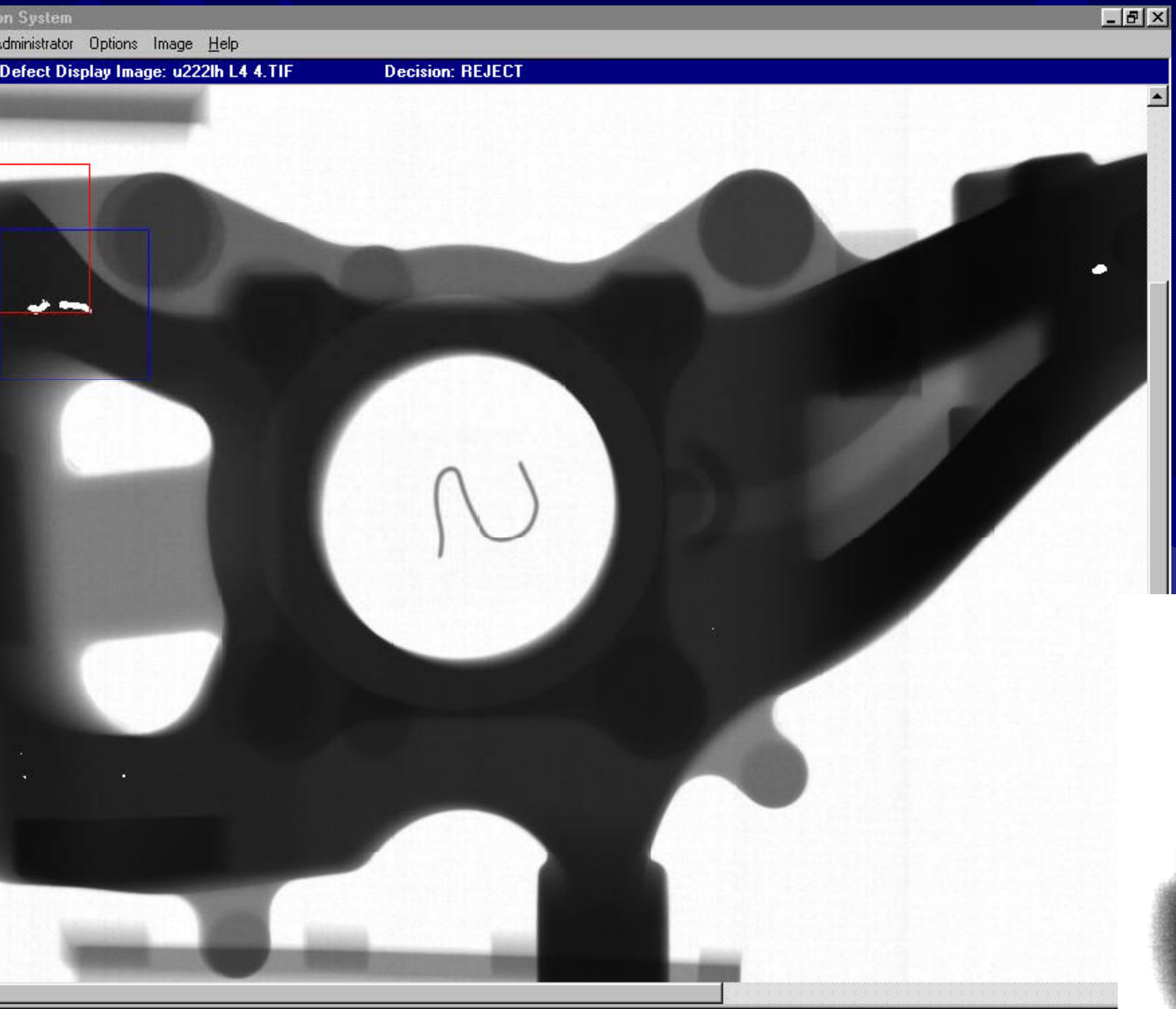
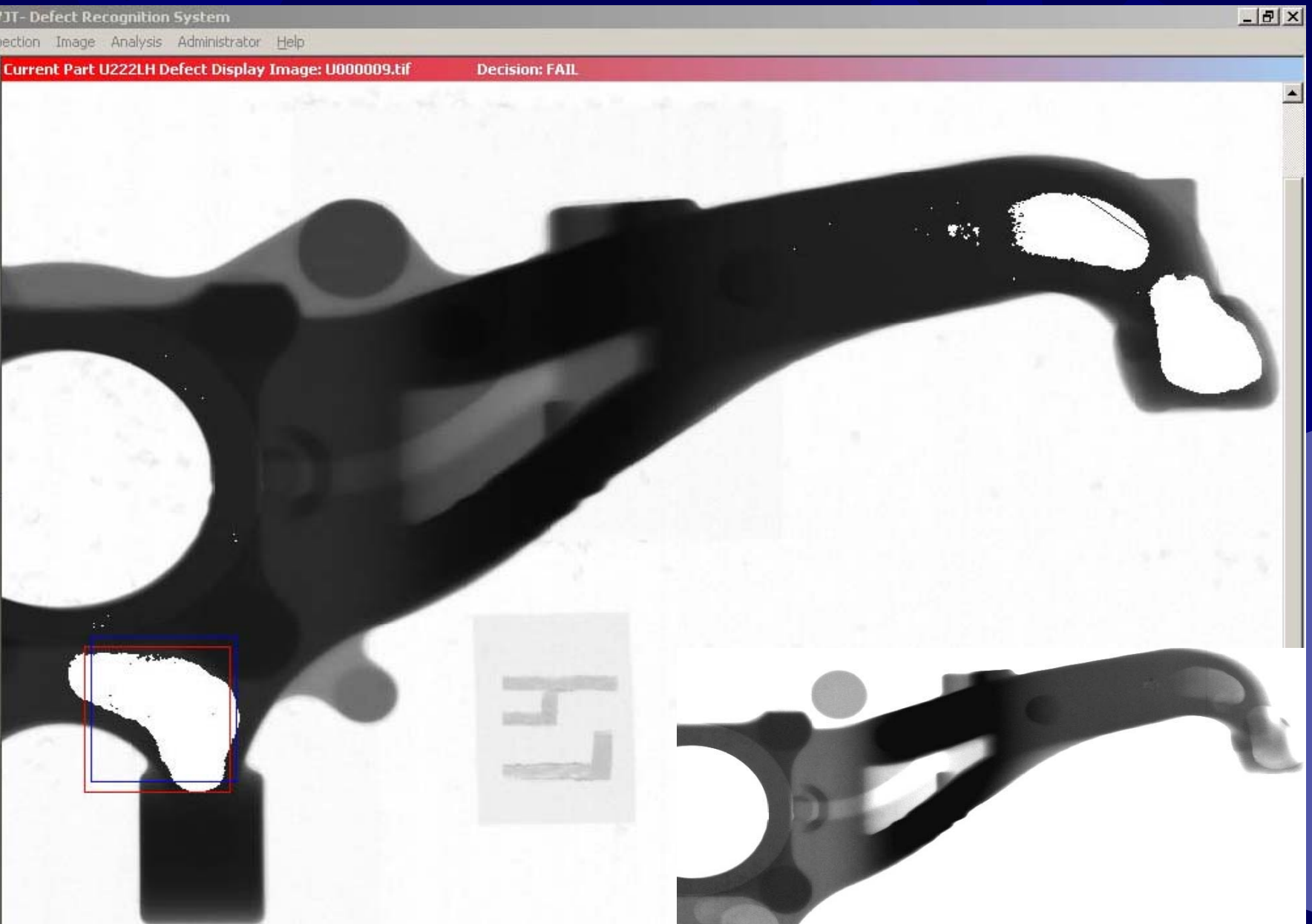


Castings


JT- Defect Recognition System
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Current Part U222LH Defect Display Image: U000009.tif
Decision: FAIL